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NAVAER 01-60JKE-502

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Handbook

Maintenance Instructions

NAVY MODEL

FJ-4B

AIRCRAFT

SECTION IV
UTILITY SYSTEMS AND FUEL SYSTEM

PUBLISHED BY DIRECTION OF
THE CHIEF OF THE BUREAU OF AERONAUTICS

1 August 1957
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Introduction to SECTION IV

THIS HANDBOOK IS ONE OF A SERIES OF TEN which contain instructions required by using activities for the maintenance of Model FJ-4B aircraft. These are systems type handbooks. Each system in the aircraft is covered completely in a particular handbook. This includes all hydraulic, pneumatic, mechanical and electrical portions of the system. This has been done in order to assist the mechanic in becoming familiar with and in maintaining all phases of each system.

The "Utility Systems and Fuel System" handbook contains information for the maintenance of the cockpit air conditioning, the defrosting, the anti-icing, the rain removal, the cockpit pressurizing, the liquid oxygen, the anti-G suit and the fuel systems. Fuel system coverage includes the maintenance of the integral wing fuel tanks.

This handbook contains information necessary for the performance of class C and class D maintenance on those items of Contractor Furnished Equipment for which there are no separate handbooks. This handbook does not contain instructions for the overhaul of components. Such instructions are contained in separate handbooks of overhaul instructions for the individual components.

Instructions for the repair of aircraft structure are contained in the Handbook of Structural Repair (NAVAER 01-60JKD-503) for these aircraft.

Data necessary for obtaining replacement parts and for complete identification of parts are contained in the Illustrated Parts Breakdown (NAVAER 01-60JKD-504) for these aircraft.

Weight and Balance Data are found in the applicable AN 01-1B-40 handbook for each of these aircraft.

To identify and obtain these publications and handbooks covering separate items of equipment, refer to the Naval Aeronautic Publications Numerical Index (NAVAER 00-500).

BuAer Serial Numbers 139531 through 139555, 141444 through 141489 and 143493 through 143643 have been assigned to the FJ-4B. In addition, a lower case letter has been made a part of each serial number as it is painted on the aircraft. These lower case letters have been assigned to blocks of serial numbers as follows:

SERIAL NUMBER	LETTER
139531 through 139555	i
141444 through 141489	j
143493 through 143542	k
143543 through 143593	l
143594 through 143643	m

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Section IX ELECTRONIC SYSTEMS

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FJ-4B Airplane

GENERAL INFORMATION

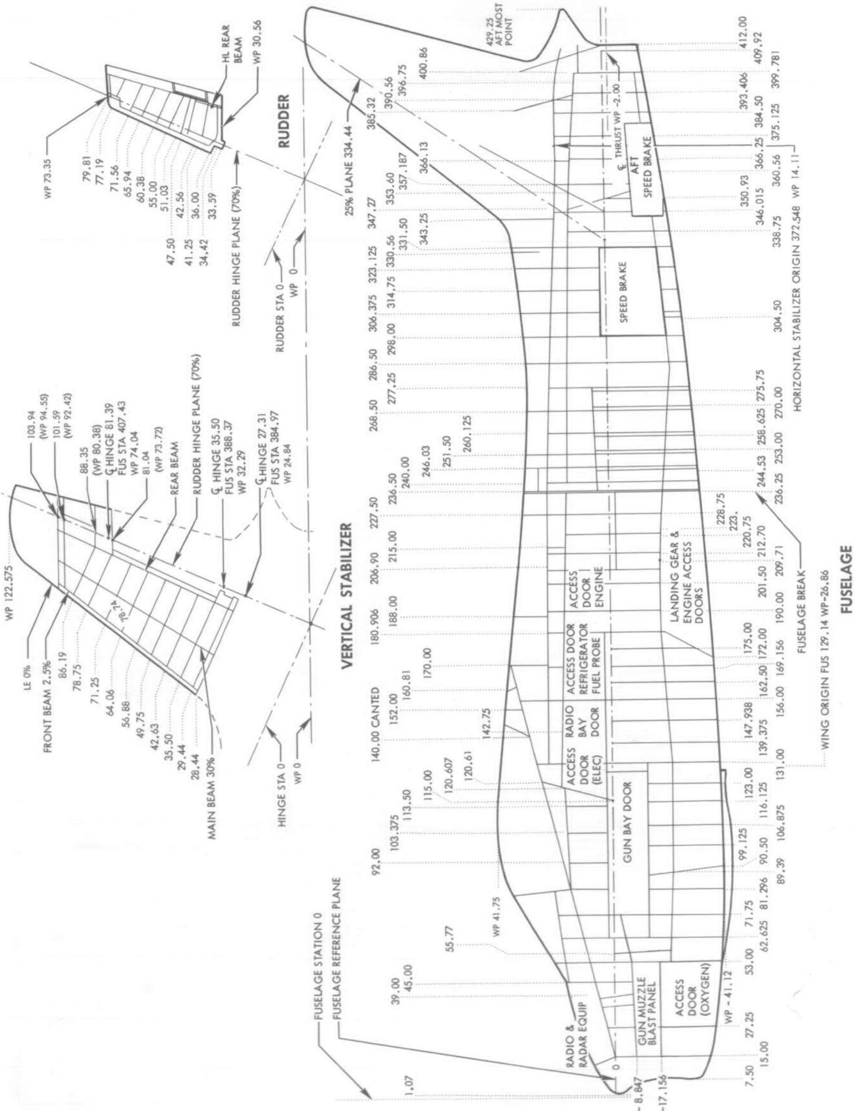


Figure No. 4-1. Airplane Stations (Sheet 1)

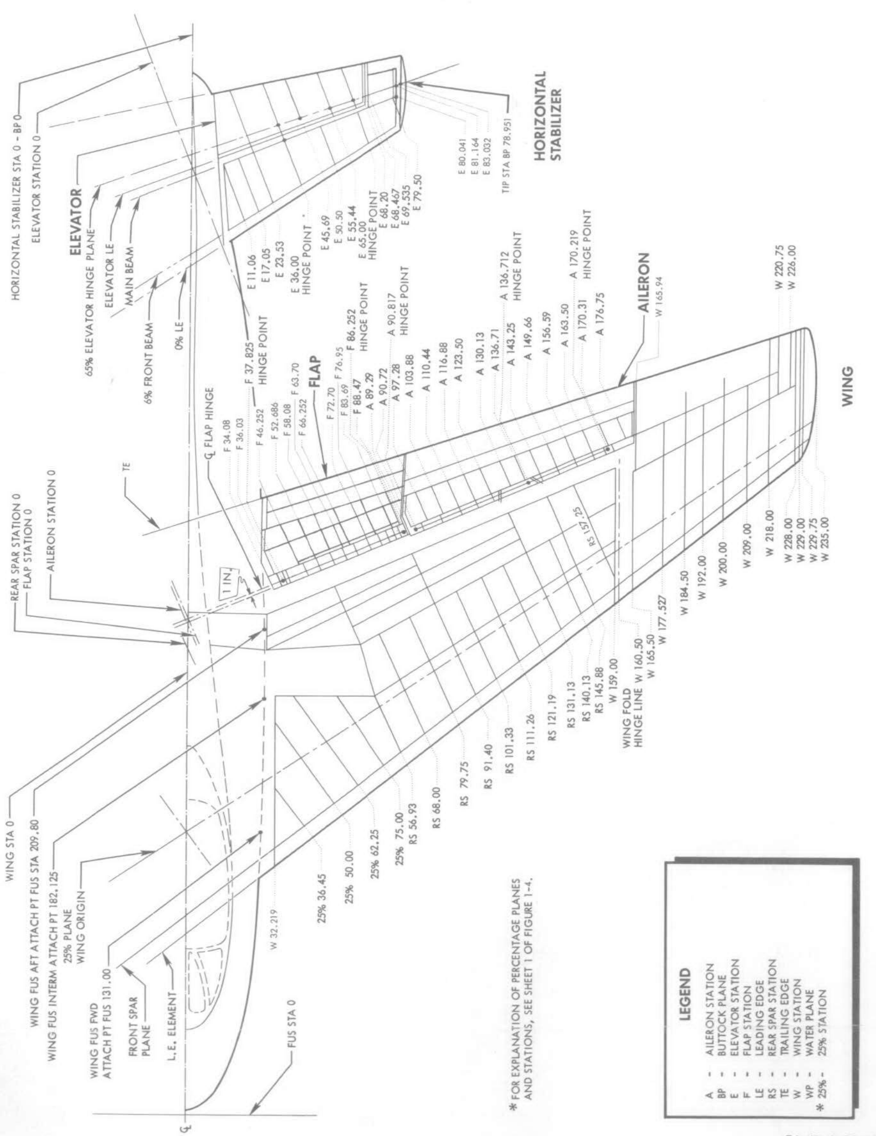


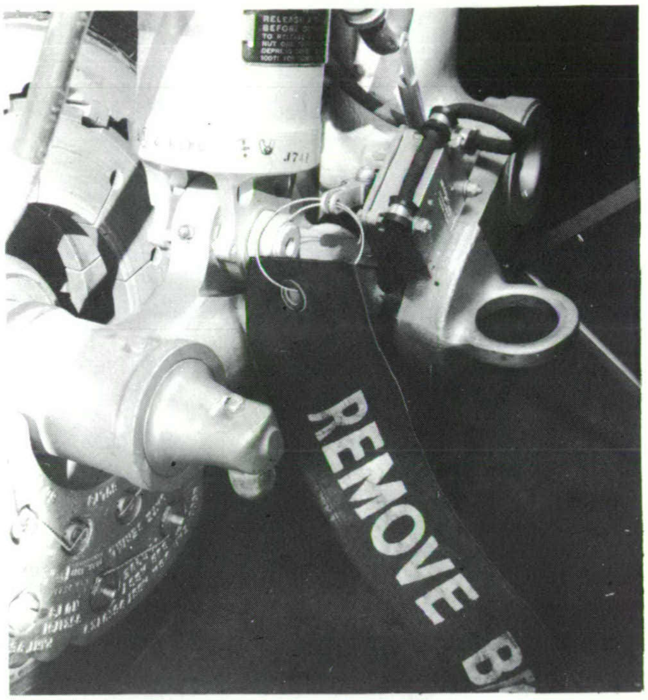
Figure No. 4-1. Airplane Stations (Sheet 2)

Warning Ground safety locks and pins are to be installed at all times, except for flight and gear retraction check. Remove immediately before flight and stow in cockpit map case.

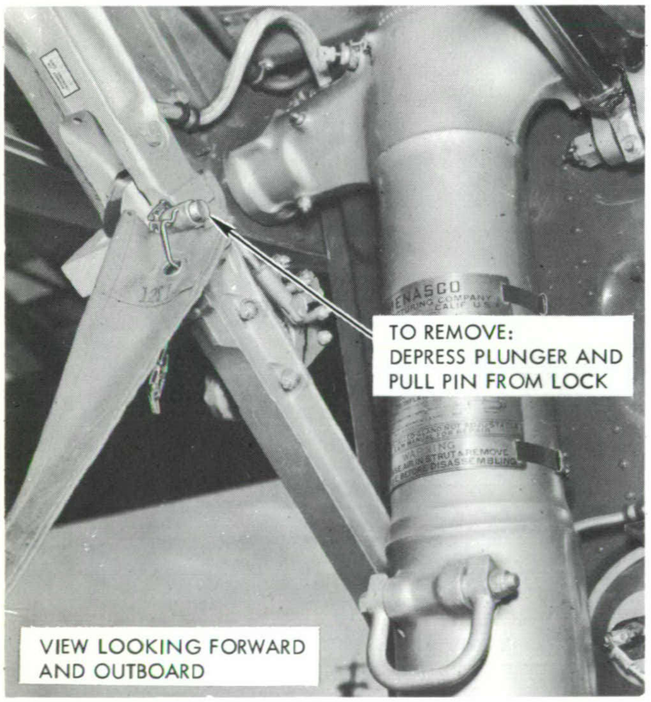
A time-saving method for performing certain testing procedures on the airplane (which normally would require the use of ground jacks) may be accomplished by disabling the ground safety switch. Attach a red warning flag, similar to the flags used on the landing gear ground safety locks, whenever the ground safety switch is disabled.

Warning When a red warning flag has been attached to the ground safety switch to indicate a disabled switch, never remove flag from the unit until switch has been properly connected.

GROUND SAFETY SWITCH



NOSE LANDING GEAR GROUND SAFETY LOCK



Note There is no ground safety lock for the arresting gear.

MAIN LANDING GEAR GROUND SAFETY LOCK

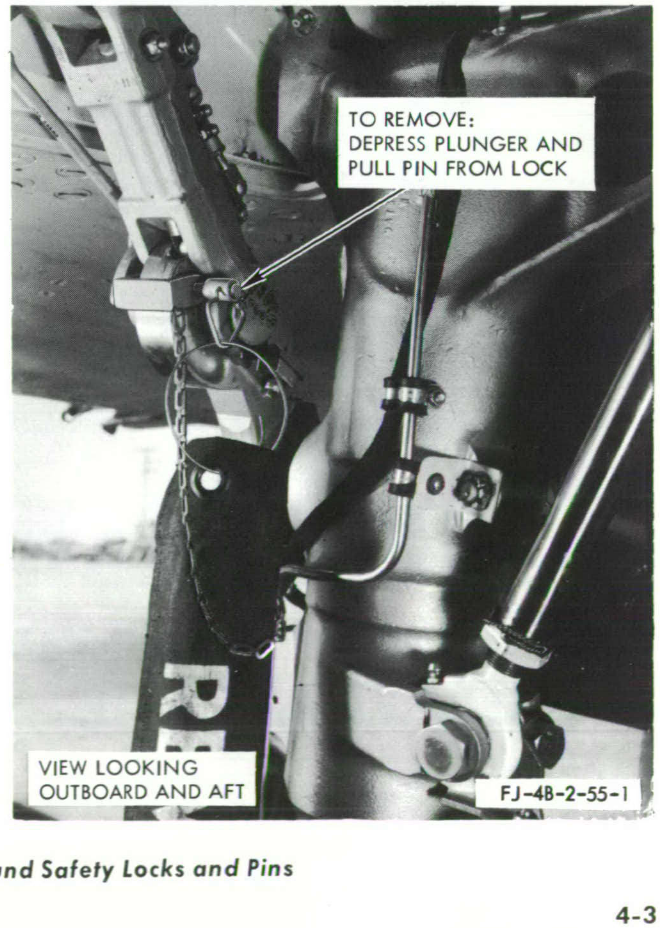
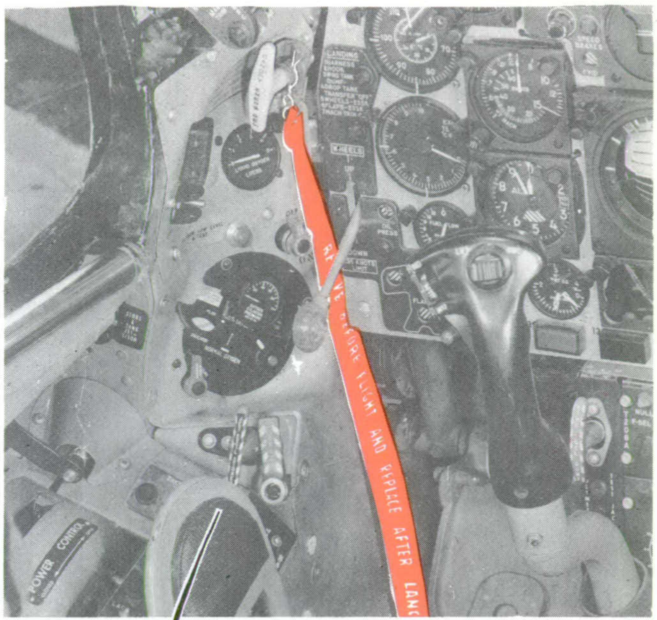


Figure No. 4-2. External Ground Safety Locks and Pins

Warning

- Keep out of the cockpit unless maintenance is required.
- Always consider the emergency escape system loaded and armed.
- Know where the safety pins are and be certain of their installation.
- Do not manipulate linkage wihout full knowledge of the emergency escape system.
- Do not use linkage or handles as handgrips.
- The catapult cartridge, canopy remover, remover initiators and exactor are ordnance items and should be checked and maintained only by qualified personnel.



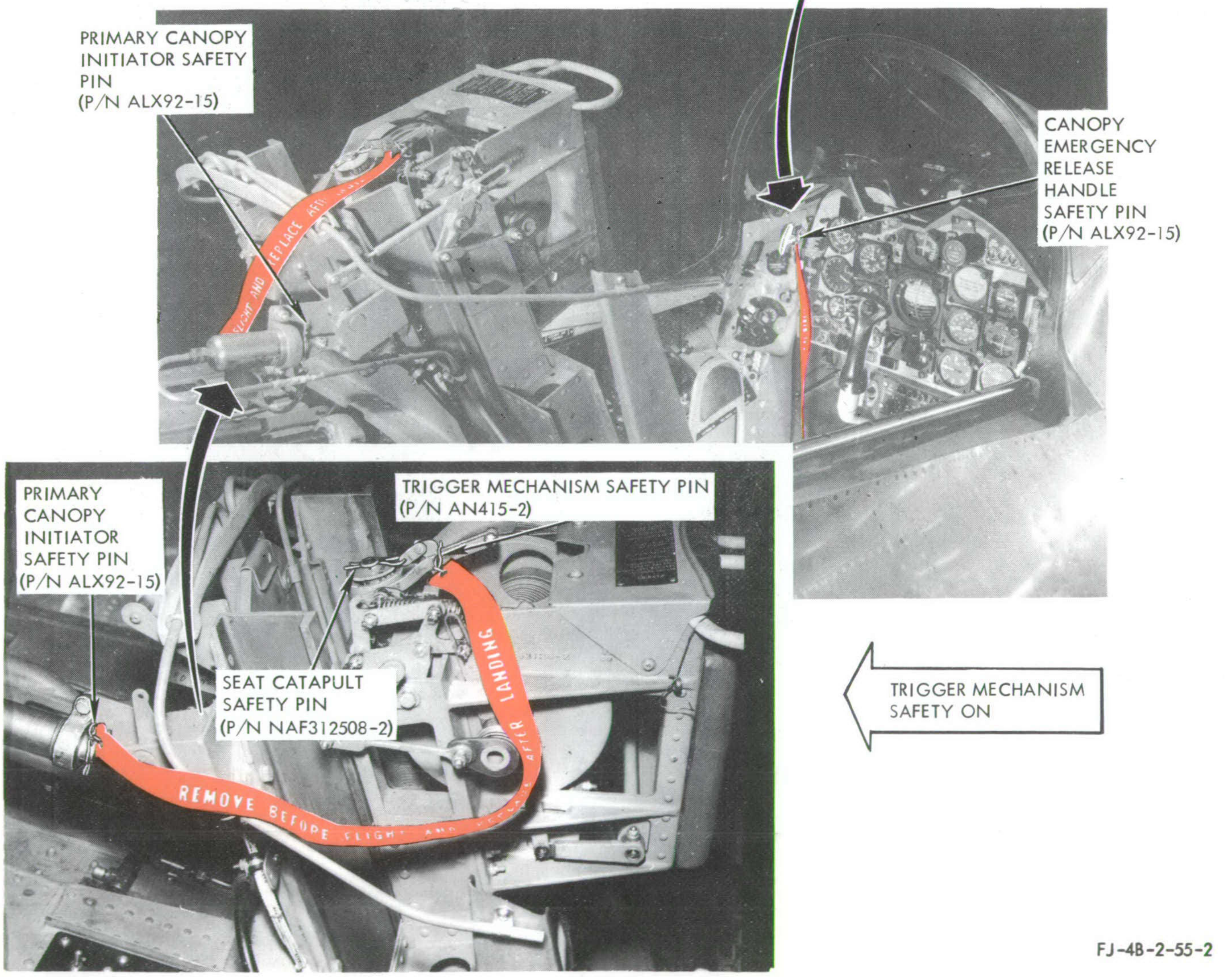
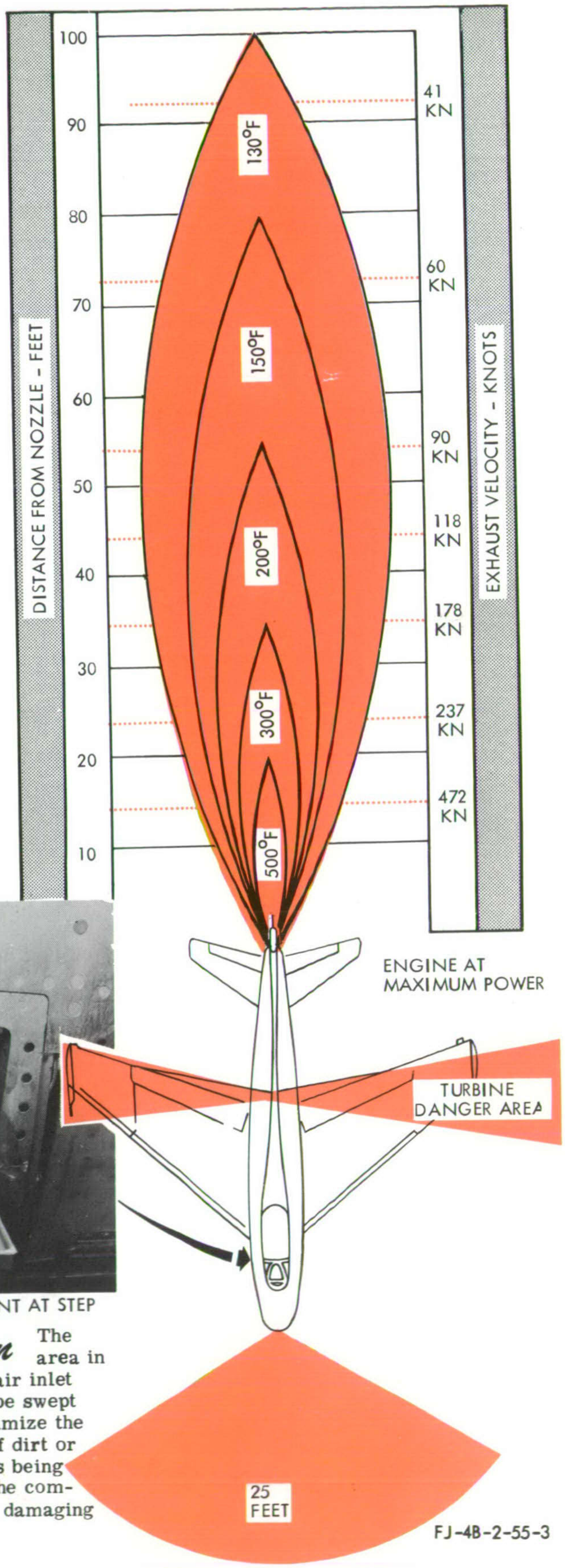


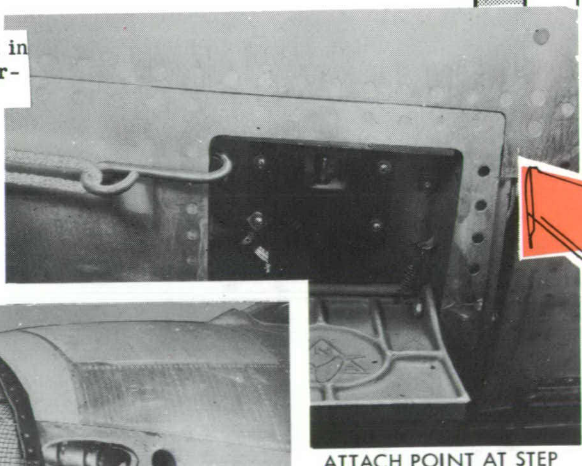
Figure No. 4-3. Emergency Escape System Ground Safety Pins

Warning

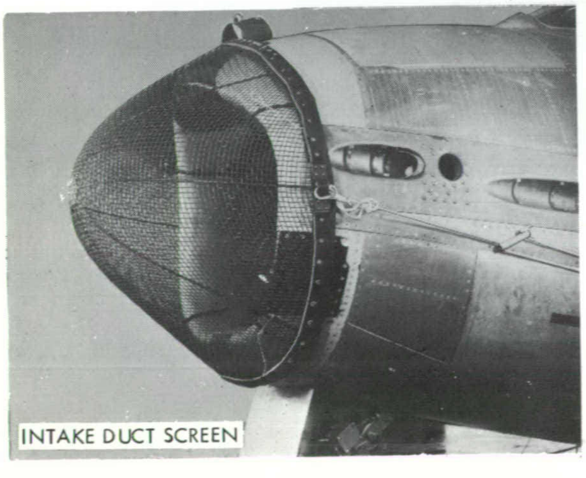
- Do not stand near the front of the air inlet duct while the engine is operating.
- Always approach the airplane from the side but not in the plane of rotation of the turbine when the engine is running.
- Avoid wearing hats or other loose clothing when working in the run-up area.
- Do not carry loose articles such as pencils, key rings or tools when near the air inlet duct.
- Do not foolishly experiment with the margin of safety by standing near, or feeling with your hand, the suction created by the engine.
- Do not stand on wing of the airplane while engine is operating, unless assistance is required during cockpit check-out or functional check of equipment.
- The loudest sustained noise produced by man is the noise of a jet engine operating at high rpm. Jet-engine noise is dangerous to personnel working in the immediate area. At distances from 50 to 200 feet, wear ear plugs and at distances within a radius of 50 feet, wear ear plugs and a type of over-the-ear protector. Prolonged exposure to jet-engine noise can cause pain and damage to the inner ear. Other effects of prolonged exposure are fatigue, nervousness and impairment of hearing.
- Do not stand at the edge of the blast area as the temperature could suddenly increase with engine speeds.



Place retaining rope hook in existing hole located in forward frame of step.



ATTACH POINT AT STEP



Caution The area in front of the air inlet duct should be swept clean to minimize the possibility of dirt or other objects being drawn into the compressor and damaging the engine.

Figure No. 4-4. Ground Run-up Danger Areas

Warning The surface controls, movable doors and units can cause serious injury to personnel. Stay clear of these areas when the power is on. Maintenance and servicing personnel should use extreme caution if it is necessary to be in these areas. Do not operate any surface control or units until the areas are clear of personnel or equipment.

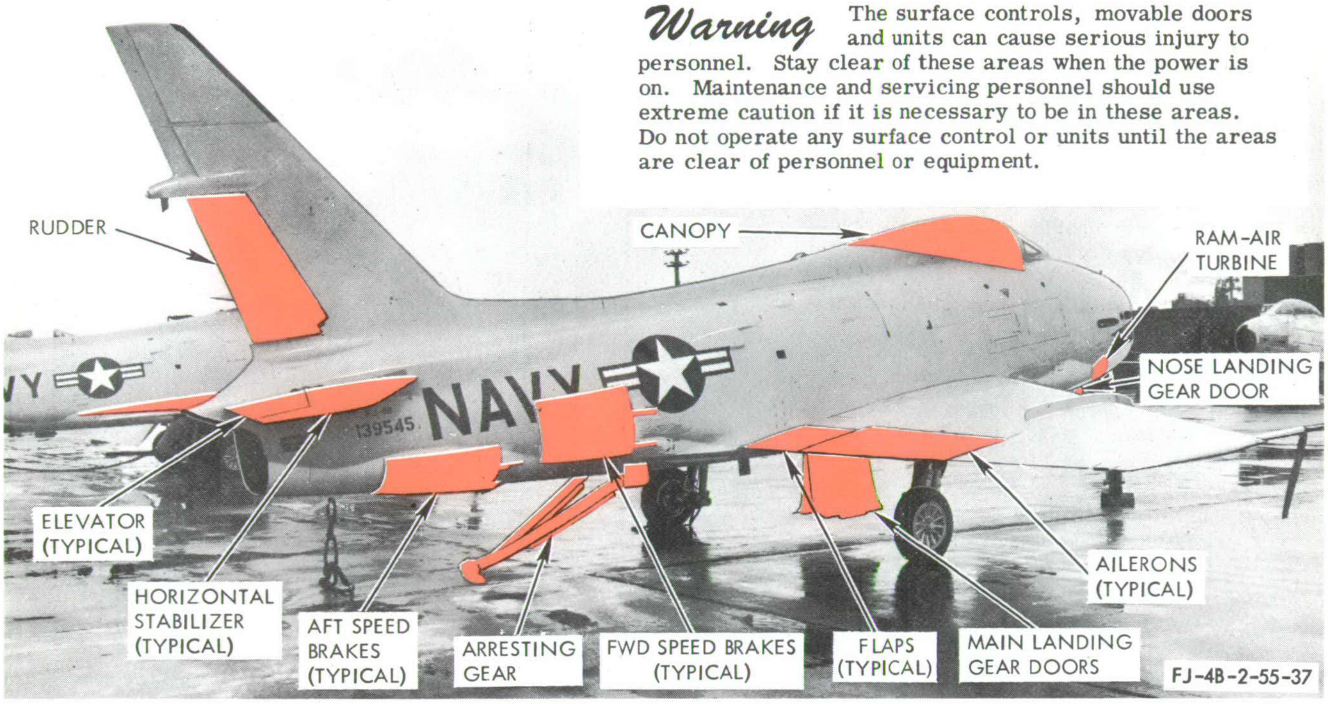


Figure No. 4-5. Movable Surface Hazards

To remove the pilot after a crash landing, proceed as follows.

A. Remove canopy by using manual canopy release handle located on left-hand side of canopy frame above "RESCUE" marking. (If canopy is jammed, break glass with battering ax or tool.) Use extreme caution not to injure pilot.

B. Open quick-release on seat belt (cut if necessary).

C. Release parachute harness (cut if necessary).

D. Disconnect oxygen and radio cord, etc.

E. Carefully remove pilot.

Warning Do not actuate the face curtain or any parts of the emergency escape system.

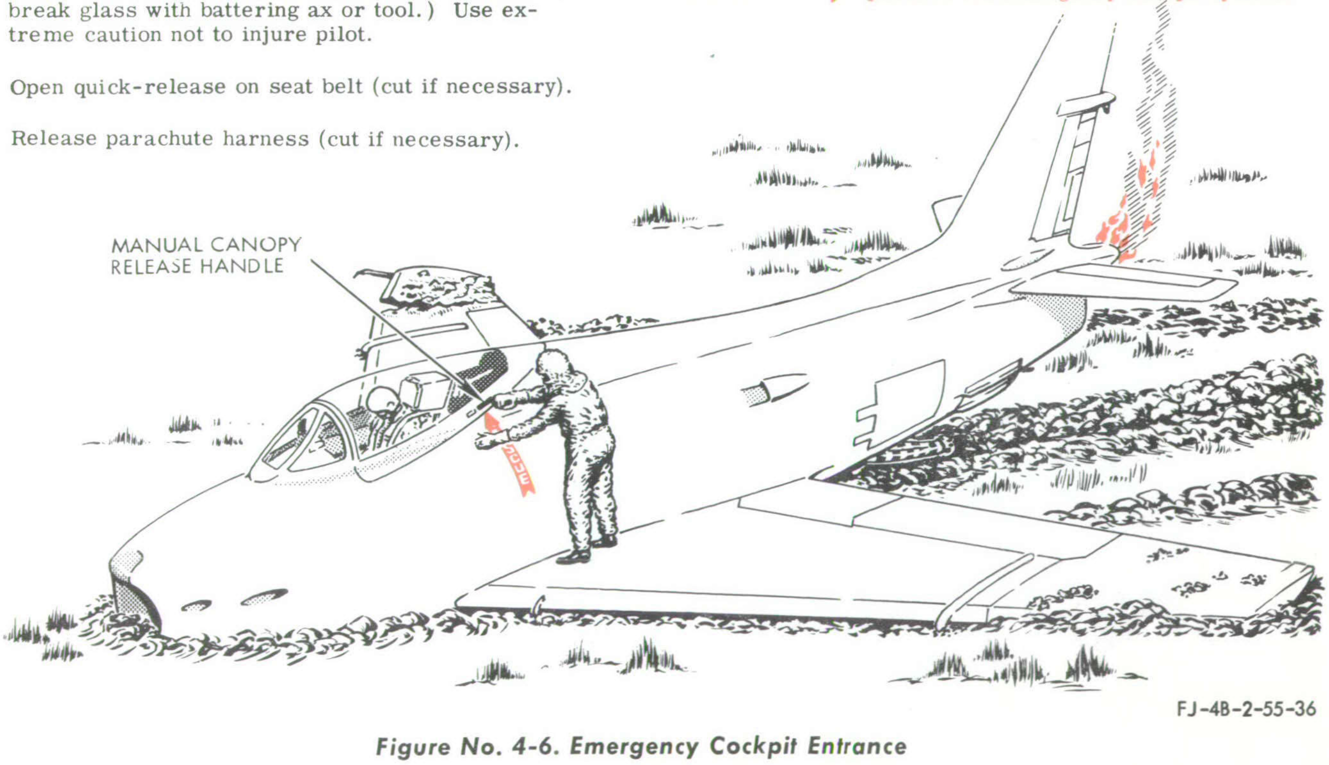
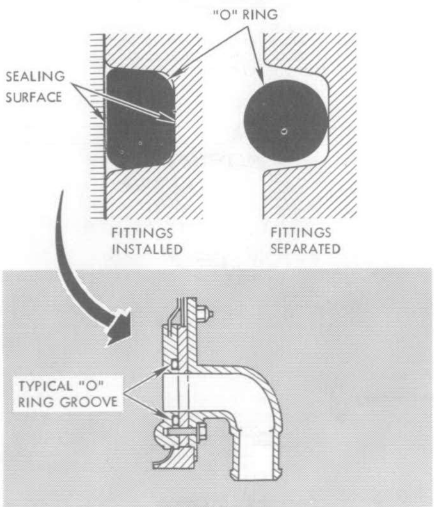


Figure No. 4-6. Emergency Cockpit Entrance

"O" RING INSTALLATION

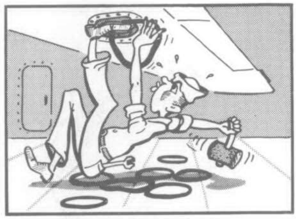
The fuel system has three provisions for sealing removable fittings and line couplings: the open groove "O" ring fitting, the double and single "O" ring coupling and the sleeve seal coupling (figure 4-8). The "O" ring is used in sealing fuel cell fittings by providing a groove in the fitting attached to the tank. The face connecting to the tank fitting is smooth and does not have an "O" ring groove. There is only one "O" ring between any two metal surfaces. An "O" ring fitting seal consists of two sealing surfaces: one (an integral part of the cell fitting) at the bottom end of the groove, the other, the contacting face of the component part. Where the "O" ring groove is on its side or upside down, it is necessary to retain the "O" ring in its correct location during installation of various components by means of an adhesive substance such as petrolatum (item 100, materials list). To install the "O" ring, clean all parts and wash hands; then, uniformly fill groove approximately half full of petrolatum. Place "O" ring in groove and work with finger tips until a uniform contact is made with bottom of groove. Using an absolutely clean, lint-free cloth, remove all excess petrolatum from face of fitting and exposed face of "O" ring. Cleaning ensures the "O" ring staying in its groove rather than being dislodged during installation by sticking to some other component part.

Note On installations where the "O" ring groove faces up, an adhesive substance should not be used and the groove should be completely free of foreign matter.



The double and single "O" ring couplings, when properly secured, effect a seal by compressing the "O" ring or rings and expanding them against the lines. The double "O" ring coupling consists of a body, two split washers, two "O" rings, a two piece retainer and a nut.

The double "O" ring is used when two lines are connected together. When a double "O" ring coupling is installed, the body, a split washer and an "O" ring are placed on one line and the nut, a split washer and an "O" ring are placed on the other line. The split retainer is so placed that it covers the ends of the lines and the line beads are under the retainer. The body is then slipped over the retainer and the nut is torqued with spanner wrenches and safetied to the body with AN995F32 lockwire. The single "O" ring coupling consists of a nut, two split washers and an "O" ring. It is generally used when a line is attached to a fitting. When a single "O" ring coupling is installed, the nut, washers and "O" ring are installed on the line ("O" ring is installed between the two washers). The nut is then torqued with a spanner wrench and safetied to the fitting with lockwire.



INSTALLING "O" RINGS

Caution To ensure a satisfactory seal of the "O" ring fitting, the following precautions should be observed at all times:

A. Be sure sealing surface is thoroughly clean and dry before assembling fittings.

B. Be sure to insert an "O" ring in every "O" ring fitting.

C. Be sure to use correct type and size "O" ring on all fittings.

D. Be sure there are no imperfections in sealing surface of fittings.

E. Do not attempt to eliminate an imperfection in sealing surface without proper rework coverage.

F. When using cutting tools or rivet guns in vicinity of an "O" ring sealing surface, use special precautions to avoid scarring sealing surface.

The sleeve type seal coupling is used on vent and dump line installations and consists of a split sleeve, a sleeve, a sleeve seal and a Marman clamp. To install this type coupling, fold back half of the sleeve seal and slip onto sleeve. Slide this sleeve with the sleeve seal partially installed onto line. Place the split seal so that it covers the ends of the lines and so that the line beads are under the retainer. The sleeve is then slipped over the split halves and the sleeve seal is folded down into place so that it covers the entire sleeve. Install Marman clamp over sleeve seal installation. Be careful not to damage sleeve seal by using tools to pry against it. Use only the hands to install seal. If seal is installed correctly as shown , no tools will be necessary.

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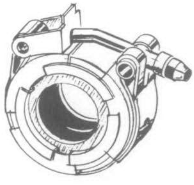
Figure No. 4-7. "O" Ring Installation



MARMAN 43688 SERIES
(TORQUE TO 25-30 INCH-POUNDS.)



MARMAN 365-63-413-SH
(TORQUE TO 25-30 INCH-POUNDS.)



MARMAN C15 SERIES
(17354 BASIC SHELL NO.)
(TORQUE TO 50-70 INCH-POUNDS.)



MARMAN 16281 SERIES
(TORQUE TO 70-90 INCH-POUNDS.)
MARMAN 42990-5.000-S
(TORQUE TO 30 INCH-POUNDS.)
MARMAN 17088-100
(TORQUE TO 70-90 INCH-POUNDS.)
MARMAN 4369-2.812-S
(TORQUE TO 30 INCH-POUNDS.)



MARMAN 24502
-200 (TORQUE TO 90 INCH-POUNDS.)
-100 (TORQUE TO 90 INCH-POUNDS.)
-150 (TORQUE TO 90 INCH-POUNDS.)



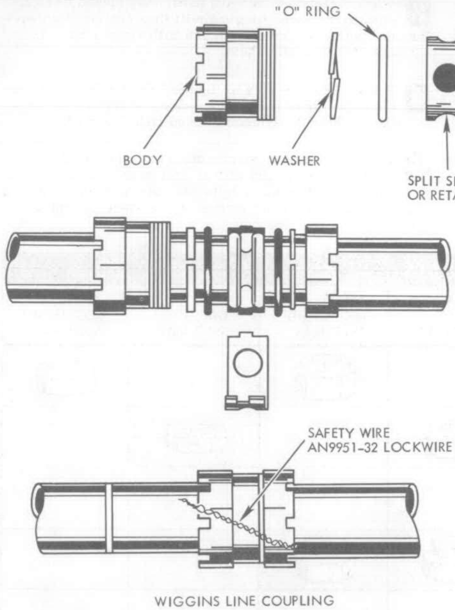
AWICA 40237 SERIES
(TORQUE TO 70-90 INCH-POUNDS.)



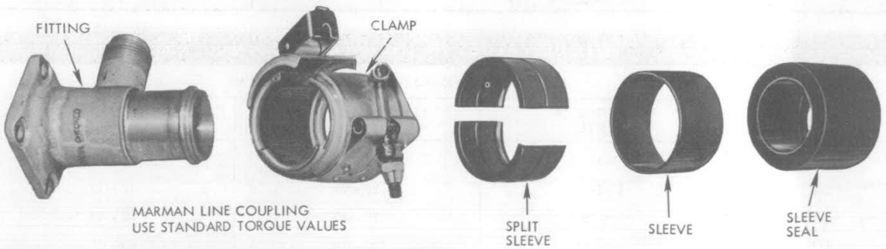
MARMAN 42535-1.50-S
(TORQUE TO 30 INCH-POUNDS)

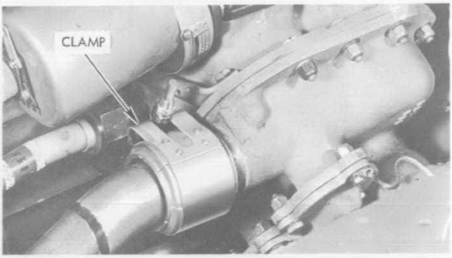
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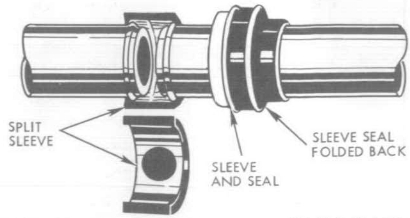
Figure No. 4-8. Installation of Line Couplings (Sheet 1)



WIGGINS LINE COUPLING CHART			
TUBE OD	SIZE	"O" RING MS29513	TORQUE
3/4 IN.	12 D	210	7 FT LB
1 IN.	16D	214	13 FT LB
1-1/4 IN.	20D	218	18 FT LB
1-1/2 IN.	24D	325	30 FT LB
1-3/4 IN.	28D	327	32 FT LB
2 IN.	32D	329	33 FT LB
2-1/2 IN.	40 D	333	35 FT LB







FJ-4B-2-48-162A

Figure No. 4-8. Installation of Line Couplings (Sheet 2)

TORQUE INFORMATION

The torque table is to be used as a guide in tightening nuts, bolts and screws whenever specific torque values are not called out in maintenance procedures. Using the proper torque allows the structure to develop its designed strength and greatly reduces the possibility of failure due to fatigue. Following are a few items you should be aware of when using this table:

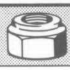
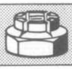
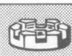
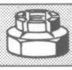
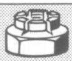
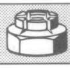
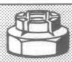
1 To convert to foot-pounds, divide inch-pounds by 12.

2 Threads must be free from grease or oil. Lubrication changes the torque value and will result in overtorquing.

3 When castellated nuts are used, they should be tightened to the lower torque limit; then continue tightening until cotter pin hole is aligned with slots in nut. Do not back off nut to align hole.

4 When it is necessary to tighten from the bolthead, use the high side of the torque range. If necessary, the maximum allowable tightening torque may be used.

5 When corrosion-resistant steel bolts are used, they should be lubricated with an anti-seize compound. Corrosion-resistant steel bolts and nuts must be used together. Use shear nut torque values when tightening these bolts.

HEX NUTS						
"AN" NUMBER AND DESCRIPTION	AN363 REG HEIGHT 550°F MAX	AN363C REG HEIGHT 800°F MAX	AN364 THIN 250°F MAX	AN365 REG HEIGHT 250°F MAX	AN320 THIN 550°F MAX	AN310 REG HEIGHT 550°F MAX
STEEL CADMIUM-PLATED						
STEEL CADMIUM-PLATED						
CORROSION-RESISTANT STEEL						
STEEL CADMIUM-PLATED						
CORROSION-RESISTANT STEEL						

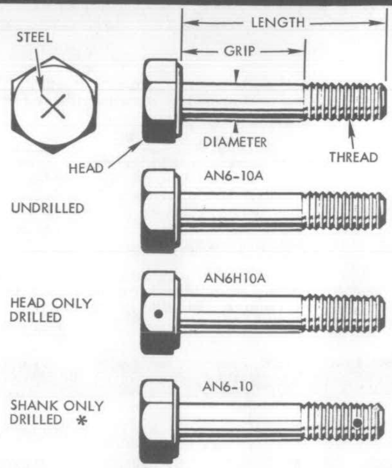
TORQUE VALUES IN INCH-POUNDS			
WRENCH SIZE	STANDARD NUTS, BOLTS AND SCREWS		
	BOLT, STUD OR SCREW SIZE	TENSION-TYPE NUTS AN310 AND AN365	SHEAR-TYPE NUTS AN320 AND AN364
11/32	8-36	12 - 15	7 - 9
3/8	10-32	20 - 25	12 - 15
7/16	1/4-28	50 - 70	30 - 40
1/2	5/16-24	100 - 140	60 - 85
9/16	3/8-24	160 - 190	95 - 110
5/8	7/16-20	450 - 500	270 - 300
3/4	1/2-20	480 - 690	290 - 410
7/8	9/16-18	800 - 1000	480 - 600
15/16	5/8-18	1100 - 1300	660 - 780
1-1/16	3/4-16	2300 - 2500	1300 - 1500
1-1/4	7/8-14	2500 - 3000	1500 - 1800
1-7/16	1-14	3700 - 5500	2200 - 3300

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Figure No. 4-9. Torque Information (Sheet 1)

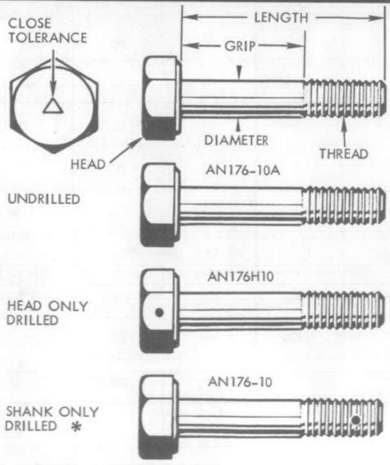
BOLTS

BASIC NUMBER	DIAMETER	THREADS PER INCH
AN3	10 *	32
AN4	1/4 *	28
AN5	5/16	24
AN6	3/8	24
AN7	7/16	20
AN8	1/2	20
AN9	9/16	18
AN10	5/8	18
AN12	3/4	16
AN14	7/8	14
AN16	1	14



CLOSE TOLERANCE BOLTS

BASIC NUMBER	DIAMETER	THREADS PER INCH
AN173	10 *	32
AN174	1/4 *	28
AN175	5/16	24
AN176	3/8	24
AN177	7/16	20
AN178	1/2	20
AN179	9/16	18
AN180	5/8	18
AN182	3/4	16
AN184	7/8	14
AN186	1	14



* Bolts 1/4-inch diameter and smaller with cotter pin holes may not be used with self-locking nuts.

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Figure No. 4-9. Torque Information (Sheet 2)

The torque table is to be used as a guide in assembling flared tubes and flexible hoses. A few general instructions are included to help you, as a systems mechanic, do a better job.

1 It is absolutely necessary that open ends of tubing and all fittings on units be kept capped until they are connected into the system.

2 Route tubing and flexible hose so that they clear adjacent structure, hot-air ducts, electrical cables and equipment, flight control cables and oxygen lines and equipment. All fluid and fuel lines should be routed at least 6 inches from and below electrical cable, if possible, to prevent fire due to line leakage.

3 Apply lubricants to male threads of fittings sparingly and carefully. Allow none to enter the system to cause a malfunction.

4 Before assembly, inspect tube flares for cracks, burrs, sharp edges and equal roundness with sleeves. Tight sleeves will not be considered cause for rejection. Nuts should turn freely on the sleeves.

5 When tube is in position, the tube flares should meet the fittings squarely and fully. Never use nut to draw flare to fitting as flare might be easily spun off or damaged.

6 Start nuts on fittings and turn until flares and sleeves are firmly seated. Never use a wrench until nut is finger-tight. Use a wrench on the hex or flat of the body of the fitting to prevent turning of the fitting.

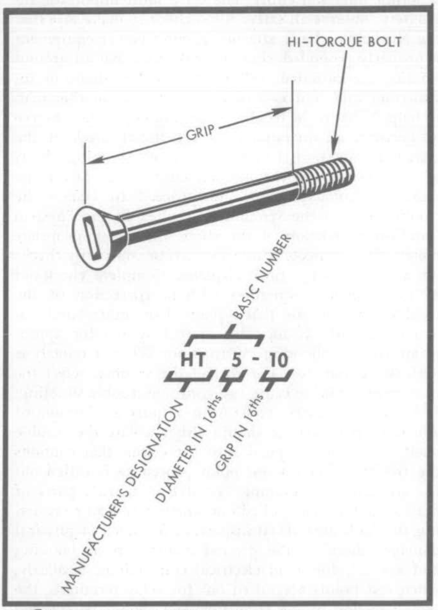
Note Torques given apply to the tubing material, regardless of the fitting or nut material.

FLARED TUBING AND FLEX HOSE TORQUE VALUES

TUBE OD INCHES	"B" NUT WRENCH SIZE	5052-O AL ALLOY TUBING		6061-T6 (61S-T6) AL ALLOY TUBING AND EQUIVALENT FLEX HOSE ASSEMBLY		MIL-T-6845 STAINLESS STEEL TUBING		ALUMINUM ALLOY TUBING FOR USE ON OXYGEN LINES ONLY	
		IN. LB MIN	IN. LB MAX	IN. LB MIN	IN. LB MAX	IN. LB MIN	IN. LB MAX	IN. LB MIN	IN. LB MAX
1/8	3/8	20	25						
3/16	7/16	25	35	30	70	90	140		
1/4	9/16	40	65	70	120	135	185		
5/16	5/8	60	80	70	120	180	230	100	125
3/8	11/16	75	125	130	180	270	345		
1/2	7/8	150	250	300	400	450	525		
5/8	1	200	350	430	550	650	750		
3/4	1-1/4	300	500	650	800	900	1100		
1	1-1/2	500	700	900	1100	1200	1400		
1-1/4	2	600	900	1200	1450	1500	1800		
1-1/2	2-1/4	600	900	1550	1850	2000	2300		
1-3/4	2-5/8	700	1000	2000	2350	2600	2900		
2	2-7/8	800	1100	2500	2900	3200	3600		

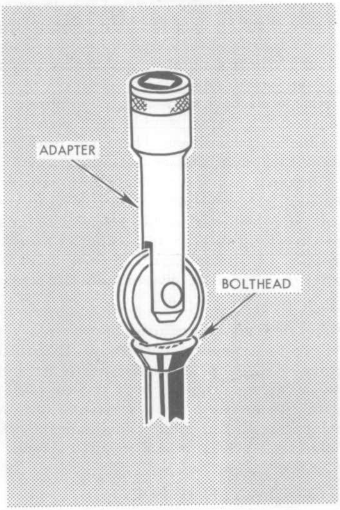
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Figure No. 4-9. Torque Information (Sheet 3)



Note DO NOT USE WITH SHEAR TYPE NUTS.

TORQUE CHART	
HT BOLT	TORQUE (±5)%
HT 4M	85 INCH-POUNDS
HT 5M	190 INCH-POUNDS
HT 6M	335 INCH-POUNDS
HT 7M	715 INCH-POUNDS
HT 8M	940 INCH-POUNDS



ADDITIONAL NUMBER INFORMATION

① FOLLOWING BASIC NUMBER = 1/64 OVERSIZE DIAMETER

② FOLLOWING BASIC NUMBER = 2/64 OVERSIZE DIAMETER

M FOLLOWING BASIC NUMBER = MODIFIED SLOT

A FOLLOWING DASH NUMBER = UNDRILLED SHANK

Note PLAIN DASH NUMBER INDICATES DRILLED SHANK.

HI-TORQUE BOLT SIZE	DRIVE SIZE	BLADE NUMBER	ADAPTER NUMBER	ADAPTER ASSEMBLY
HT 3M (3/16)	1/4	HTB 3M	HTG 34	HT 3203M
HT 4M (1/4)	3/8	HTB 4M	HTG 46	HT 3304M
HT 5M (5/16)	3/8	HTB 5M	HTG 56	HT 3305M
HT 6M (3/8)	3/8	HTB 6M	HTG 66	HT 3306M
HT 6M (3/8)	1/2	HTB 6M	HTG 68	HT 3306M
HT 7M (7/16)	1/2	HTB 7M	HTG 78	HT 3307M
HT 8M (1/2)	1/2	HTB 8M	HTG 88	HT 3308M
HT 9M (9/16)	1/2	HTB 9M	HTG 98	HT 3309M
HT 10M (5/8)	1/2	HTB 10M	HTG 108	HT 3310M

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Figure No. 4-10. Hi-Torque Bolts

TEST POINT TROUBLE SHOOTING.

To ease and expedite electrical maintenance, test point trouble shooting data has been incorporated in system trouble isolation procedures and system wiring diagrams. As any system failure or malfunction may result from any one or a combination of electrical, hydraulic, pneumatic or mechanical reasons, all probable causes (reasons) for a stated trouble are covered in the same trouble isolation chart. There are three types of test points: major, secondary and minor. Textual references to these test points are made within each system trouble shooting paragraph and the specific location of each test point may be determined by referring to the appropriate system wiring diagram in Section X. No test point designation will be duplicated nor will more than one test point designation be given to any test point.

MAJOR TEST POINTS.

Major test points are used to isolate a power system failure to a physical portion of the airplane or to a group of systems. Major test points are symbolized on system wiring diagrams by a star encircled Arabic numeral. Major test points are referred to in text as: test point 1, test point 2, etc. Some examples of major test points are: generator and inverter outputs, power distribution connections, etc.

SECONDARY TEST POINTS.

Secondary test points are used to isolate failure to a specific system or to a specific item within a system. Secondary test points are symbolized on system wiring diagrams by an encircled capital letter(s). The letters "I" and "O" are not used to avoid confusion with the numerals one and zero. Secondary test points are referred to in text as: test point A, test point AB, etc. Some examples of secondary test points are: power inputs to individual units, tie-ins with parallel or interrelated systems, sequence switches, etc. Secondary test points for any specific system will always have as their initial indentifying letter the same letter as the initial letter of the wire numbers of that system.

MINOR TEST POINTS.

Minor test points are used to isolate failure within a unit. Minor test points are symbolized on system wiring diagrams by an encircled capital letter and Arabic numeral. The letters "I" and "O" are not used to avoid confusion with the numerals one and zero. Minor test points are referred to in text as: test point A1, test point A2, etc. Some examples of minor test points are: continuity through a switch or a relay that is part of a unit, resistance readings of items within a unit, etc. Minor test points for any specific system will always have as their initial identifying letter the same letter as the initial letter of the wire numbers of that system.

USE OF TROUBLE SHOOTING CHARTS.

The best trouble shooting aid is preventive maintenance and cleanliness. The next best trouble shooting aid is thorough knowledge of the theory and operation of the system in question. A thorough knowledge of the system permits rapid determination of the most likely probable cause for any given trouble and thereby reduces trouble shooting time and effort. The third most important aid is safety; observe all safety rules, check to make sure that the airplane and any attached ground power equipment is properly grounded, check to make sure that all ground safeties are installed, follow the trouble shooting instructions and if it is a two-man job, get another man to help. What is the trouble? Check the squawks, observe or perform an operational or functional check of the system in question. Check the trouble shooting charts of the system for the determined trouble. Select the most probable cause(s) and proceed to isolate the trouble; set up the system as specified in the "System Conditions" portion of the chart. Use the appropriate meters. Do not make ohmmeter tests or continuity checks on an electrically "hot" airplane. Complete check-out of the system in question without correction of the trouble may indicate that a parallel or interrelated system is at fault. If so, refer to that system for appropriate trouble shooting information. When a remedy is performed that does not correct the trouble, select the next most probable cause and continue trouble shooting. Isolation procedures are set up to require a minimum of effort. Each procedure should either isolate the trouble itself or isolate the portion of the circuit that contains the trouble. When a test point procedure is called out for an item (for example, a valve solenoid), parts of that procedure not spelled out which may lead to isolating the fault are: visual inspection for signs of physical damage, check of the ground connection or bonding and a check for good electrical connections. Similarly, when test points are called out for relay terminals, the switch section of the relay involved should be checked for proper action and continuity. The various portions of the trouble shooting charts and their functions are as follows:

a. TEST EQUIPMENT. This portion of the charts contains a list of all test equipment that will be required to perform any isolation procedure that follows on the same chart.

b. SYSTEM CONDITIONS. This portion of the charts specifies the desired system conditions for the tests that will follow. Some isolation procedures may require a change to these conditions; if so, the new conditions will be given in note form.

c. TROUBLE. This is the observed symptom, malfunction, or fault.

d. PROBABLE CAUSE. The probable cause(s) states the condition or reason causing the trouble. Probable causes are listed in their most likely order. The probable causes may be electrical, mechanical, hydraulic, pneumatic, etc, or a combination of these reasons.

e. ISOLATION PROCEDURE. This portion of the charts is a positive statement of action. If the probable cause is nonelectrical, there will be no mention of test points; if electrical, specific directions related to one or more test points will be given. Isolation procedures are listed in their most likely or accessible order. What meter is to be used will be determined by the required

meter reading(s). Use the appropriate system wiring diagram in Section X to locate test points and to perform wire segment continuity checks. Many isolation procedures require the use of test points located at a connector. In such cases, it is necessary to disengage the connector and to apply the test probe to the plug or receptacle portion of the connector as shown on the system wiring diagram. Connectors should never be disengaged with electrical power applied to the airplane. Do not damage connector sockets by inserting test probes.

f. METER READING. If the isolation procedure is nonelectrical, this portion of the chart will indicate that none is required. If test points have been specified in the isolation procedure, the value and type of reading will be stated. Resistance and voltage readings are the type most commonly required for the isolation procedures; values given will indicate their type and the corresponding type of meter should be used to obtain the reading.

g. REMEDY. For nonelectrical isolation procedures, the remedy will indicate the maintenance action required depending upon the results of the isolation procedure. For electrical isolation procedures, the remedy will indicate the maintenance action required for the meter reading obtained. Most remedies will indicate a definite maintenance action, but some remedies will indicate that further isolation procedures should be performed. Some meter readings will indicate that the airplane wiring is at fault (open or shorted) and the remedy will be to perform a wire segment continuity check. Such continuity checks should be performed so as to minimize effort. Remove power and disconnect wires as necessary; then, check for continuity at the most accessible mid point of the circuit, in this manner several wire segments can be checked for continuity at one time.

WARNING

Never disconnect wires or disengage disconnects with electrical power applied to the airplane. Always ground the airplane and any attached ground power equipment.

Note

Secondary test points are listed alphabetically and opposite to each applicable wiring diagram title. Figure numbers of the wiring diagrams listed can be found in the Wiring Diagram Index of Section X of this handbook. Major test points, not listed, can be found in the Starting and D-C Generating System, the D-C Power Distribution System and the A-C Power Supply and Distribution System wiring diagrams. Minor test points, also not listed, can be found by associating them with similar secondary test points.

TEST POINT	WIRING DIAGRAM TITLE
DLA-DLZ	Oxygen System
HA-HZ, HAA-HAZ	Cockpit Air Conditioning, Defrost and Anti-ice System
HPA-HPZ	Cockpit Pressurization System
QA-QZ	Fuel Transfer, and Fuel and Defuel Control System
QBA-QBZ	Fuel Boost Pumps
QCA-QCZ	In-flight Refueling System
QFA-QFZ	Fuel Transfer, and Fuel and Defuel Control System
QRA-QRF	Refueling System, Dual Level Float Test
QRG-QRN	Refueling System, Dual Level Float Test
QRP-QRT	Refueling System, Dual Level Float Test
QRU-QRZ, QSA-QSZ	Refueling System, Aft Fuselage Fuel Cell Level Control
QTA-QTZ	In-flight Refueling Tanker System

CONSUMABLE MATERIALS

ITEM NO.	NOMENCLATURE	SPECIFICATION OR STOCK NO.	MANUFACTURER	SUBSTITUTE
3	Adhesive, Rubber (EC-870)	MIL-A-1154; Stock No. G8040-273-8717	Minnesota Mining and Manufacturing Co.	
4	Adhesive, Synthetic Rubber	MIL-A-5092		

ITEM NO.	NOMENCLATURE	SPECIFICATION OR STOCK NO.	MANUFACTURER	SUBSTITUTE
31	Compound, Integral Fuel Tank, Groove Injection Sealing	PR-703A	Products Research Co.	
36	Compound, Weather Coating	A56B	B. F. Goodrich Co.	
38	Cord, Nylon	MIL-C-5040		
52	Fluid, Anti-icing (Alcohol)	MIL-F-5566		

ITEM NO.	NOMENCLATURE	SPECIFICATION OR STOCK NO.	MANUFACTURER	SUBSTITUTE
90	Methyl-ethyl-ketone	TT-M-261; Stock No. G6810-281-2762		
91	Naphtha, Aliphatic	TT-N-95; Stock No. R52N450		
92	Naphtha, Petroleum, Aromatic	TT-N-97; Stock No. W6810-244-7637		

WARNING

Naphtha is a poisonous, flammable, volatile solvent and should be used only if adequate ventilation is present. Avoid prolonged breathing of vapor.

ITEM NO.	NOMENCLATURE	SPECIFICATION OR STOCK NO.	MANUFACTURER	SUBSTITUTE
93	Nitrogen, Liquid and Gas	MIL-N-6011		
97	Oxygen, 99.5 Percent, Gas and Liquid	BB-O-925		

WARNING

Liquid oxygen is the hottest cold item in aviation. If contact is made with bare skin, seek medical care immediately.

ITEM NO.	NOMENCLATURE	SPECIFICATION OR STOCK NO.	MANUFACTURER	SUBSTITUTE
100	Petrolatum, Technical	VV-P-236; Stock No. WS9150-250-0926		
111	Sealing Compound, Pressure Cabin	MIL-S-7124		
115	Soap, Castile	MIL-S-4282		
119	Solvent, Dry Cleaning (Stoddard Solvent)	P-S-661, Type 1; Stock No. W6850-264-9039		
121	Stripper	2998	Turco Products, Inc.	
124	Tape, Adhesive, Pressure-sensitive, Water-resistant	JAN-P-127, Type II, Grade B		
126	Tape, Antichafing	Scotchcal No. 455	Minnesota Mining and Manufacturing Co.	
	Tape Activator	A-2	Minnesota Mining and Manufacturing Co.	
128	Tape Overcoating Compound	EC-866	Minnesota Mining and Manufacturing Co.	
130	Thread Compound, Anti-seize and Sealing, Oxygen Systems	MIL-T-5542; Stock No. R52C3100-600		
133	Toluol (For Use in Organic Coatings)	TT-T-548		JAN-T-171
134	Trichloroethylene, Stabilized Degreasing	MIL-T-7003		

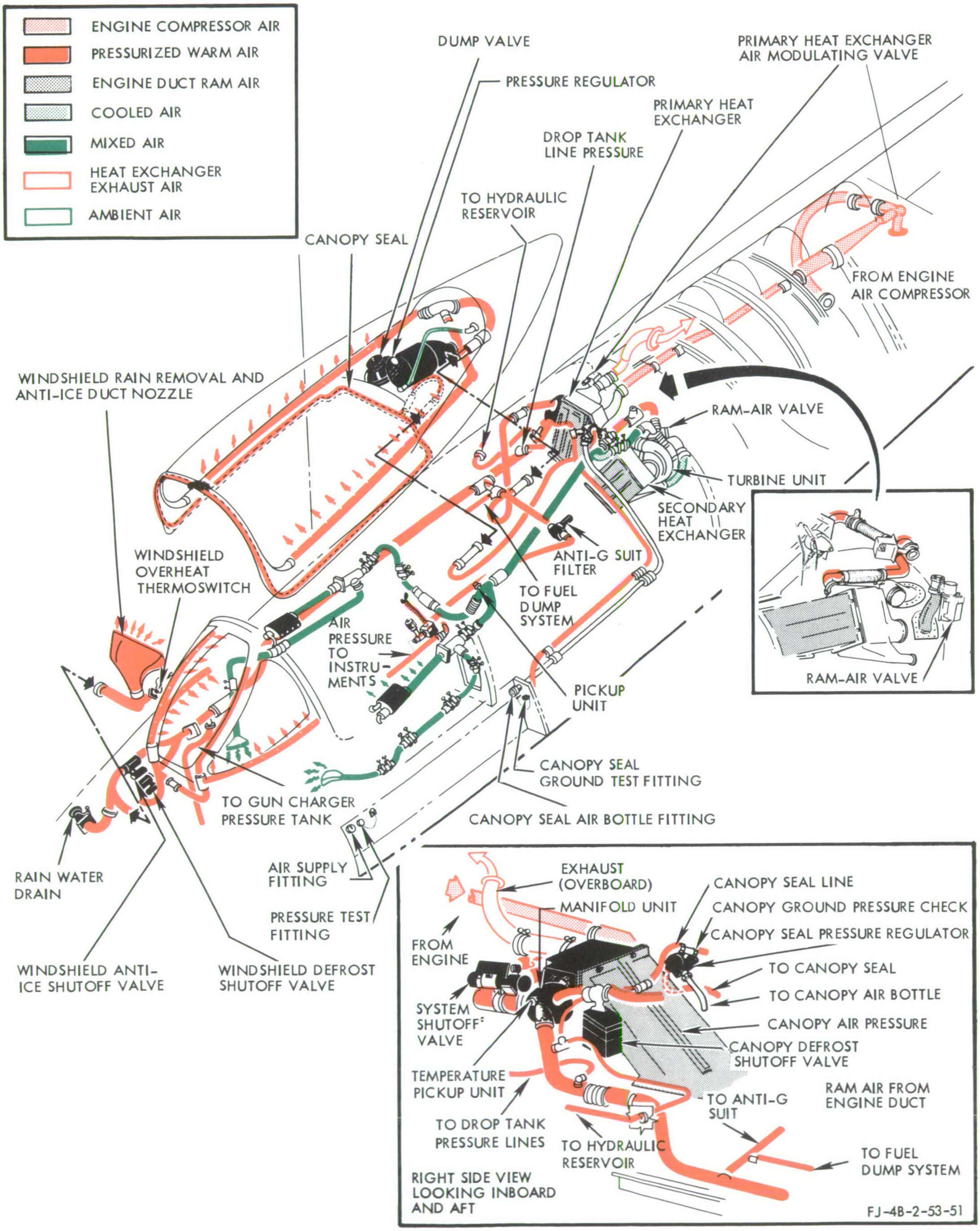


Figure No. 4-11. Cockpit Air Conditioning System; Defrost, Anti-ice and Rain Removal Systems; and Pressurizing Systems

COCKPIT AIR CONDITIONING SYSTEM

4-1. COCKPIT AIR CONDITIONING SYSTEM.

4-2. The cockpit air conditioning system (figure 4-11) provides for heating and cooling of the cockpit. The air supply for this system is derived from the thirteenth stage of the engine compressor and is routed through an emergency flow limiting nozzle to the primary heat exchanger. The supply air from the engine compressor is normally hot and no further heating is provided. However, the supply air can be cooled and the extent of cooling can be manually controlled by use of cockpit switches or automatically controlled by means of an electronic air temperature control system. When the cockpit switch setting demands cold air, a primary heat exchanger cooling-air modulating valve is energized to open, allowing an increased flow of cooled air from the engine inlet duct to pass through the primary heat exchanger, cooling the supply air. The air is then ducted overboard. If, after the primary heat exchanger modulating valve reaches full open, additional cooling is still demanded, the supply air is routed through a second flow limiting nozzle, through the secondary heat exchanger and through the cooling unit expansion turbine. The extent of cooling obtained from the air cooling unit is controlled by a cooling unit by-pass valve. This by-pass valve closes as cockpit cooling is demanded. Closing of this valve causes an increased flow of air through the expansion turbine. A turbine-driven fan extracts cooling air from the engine air inlet duct, forces the air through the secondary heat exchanger and expels the air back into the engine air inlet duct at approximately fuselage station 175. A ram-air valve, provided in the air supply duct, when open, routes engine ram air to the cockpit. The cooled air is then routed to the cockpit supply duct downstream of the cooling unit by-pass valve and into the cockpit air outlets.

4-3. FUNCTION OF COCKPIT AIR CONDITIONING SYSTEM.

4-4. The cockpit air supply is automatically maintained at a preselected temperature between −6.7°C and 135°C (20°F and 275°F) by the action of a cockpit air supply temperature regulator when the cockpit air temperature control switch is in "NORMAL" position. This regulator positions or modulates the cooling unit by-pass valve and the primary heat exchanger cooling-air modulating valve, as required, to maintain the preselected temperature. Moving the switch away from the "NORMAL" position disables the cockpit temperature control regulator and actuates the primary heat exchanger cooling-air modulating valve and the cooling unit by-pass valve toward the hot or cold position as selected. The switch can then be moved to its maintained "OFF" position to hold the valves stationary. When the cockpit temperature control switch is positioned to "COLDER," the primary heat exchanger cooling-air modulating valve will fully open and the cooling unit by-pass valve will close, routing all the air through the secondary heat exchanger and expansion turbine of the refrigeration unit. When the cockpit air temperature control switch is positioned to "HOTTER," the cooling unit by-pass valve will fully open, allowing all air to by-pass the air cooling unit (refrigeration unit). The primary heat exchanger cooling-air modulating valve will fully close, preventing the cooling air from flowing through the primary heat exchanger. The cockpit air temperature control switch is of the on-off type and the length of time the switch is positioned to "COLDER" or "HOTTER" will determine the extent of opening or closing of the cooling unit by-pass valve and the primary heat exchanger cooling-air modulating valve. When the COCKPIT AIR TEMPERATURE selector (rheostat) is turned towards "HOT" or "COLD," the resistance is decreased or increased to the cockpit air temperature control regulator which closes or opens the cooling unit by-pass valve and opens or closes the primary heat exchanger cooling-air modulating valve. The primary heat exchanger cooling-air modulating valve will always open fully before the cooling unit by-pass valve closes to eliminate unnecessary use of the air cooling unit. When the windshield anti-icing system or any of the defrosting system switches are on, the anti-ice and defrost temperature control regulator will control the primary heat exchanger cooling-air modulating valve. The cockpit supply air temperature pickup unit in the cockpit supply duct will control only the cooling unit by-pass valve. The windshield and canopy defrost systems may be turned on to provide additional heating over and above the heat supplied by the normal cabin heating system. When the COCKPIT PRESSURE control switch is positioned to "RAM EMER," the system shutoff valve will close, the ram-air shutoff valve will open and the emergency dump valve will open, thus providing an emergency ram-air system. The purpose of the emergency ram-air system is to supply the cockpit with ram air in the event the normal system becomes inoperative or the air becomes contaminated.

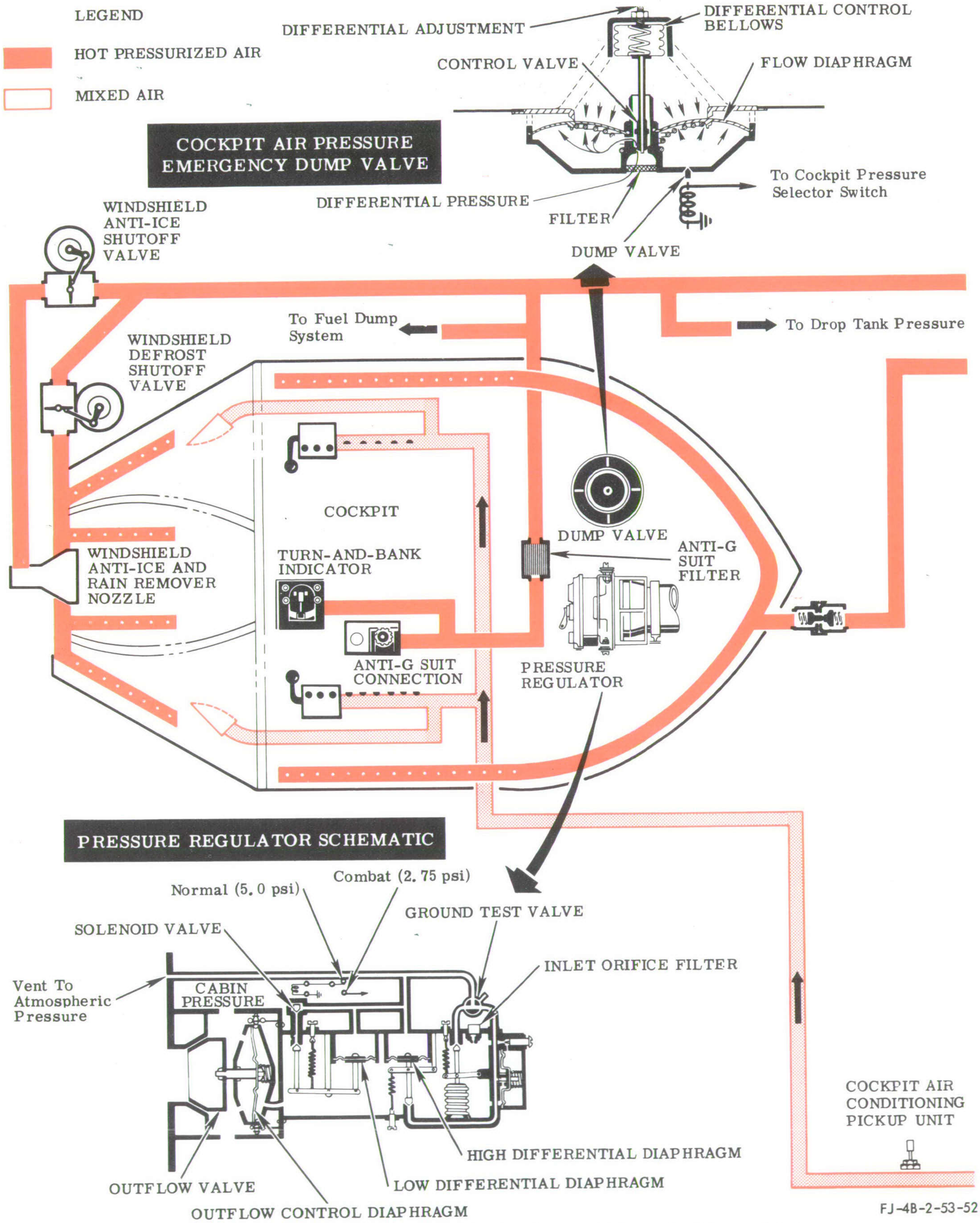


Figure No. 4-12. Cockpit Air Conditioning System; Defrost, Anti-ice and Rain Removal Systems; and Pressurizing Systems—Schematic (Sheet 1)

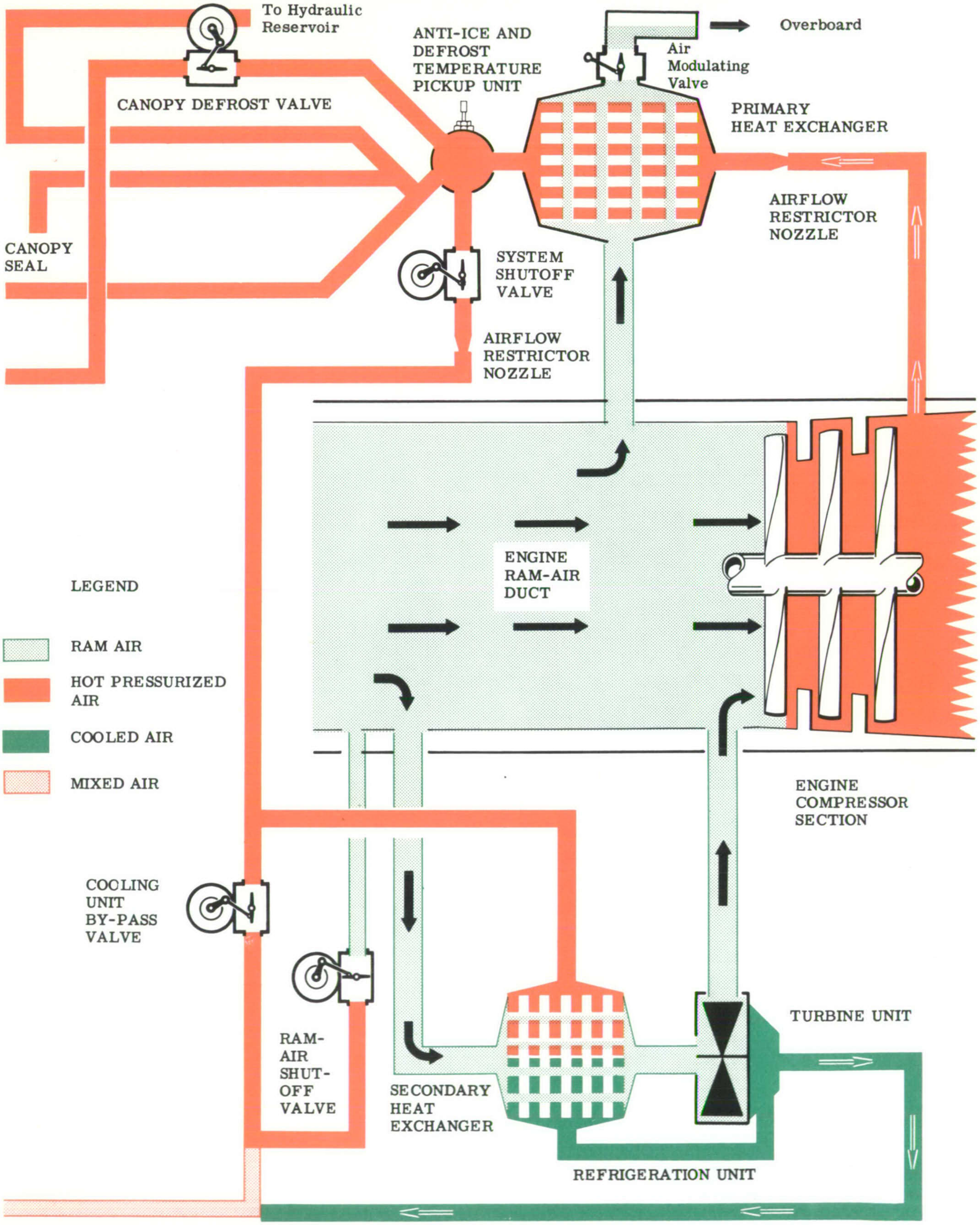


Figure No. 4-12. Cockpit Air Conditioning System; Defrost, Anti-ice and Rain Removal Systems; and Pressurizing Systems—Schematic (Sheet 2)

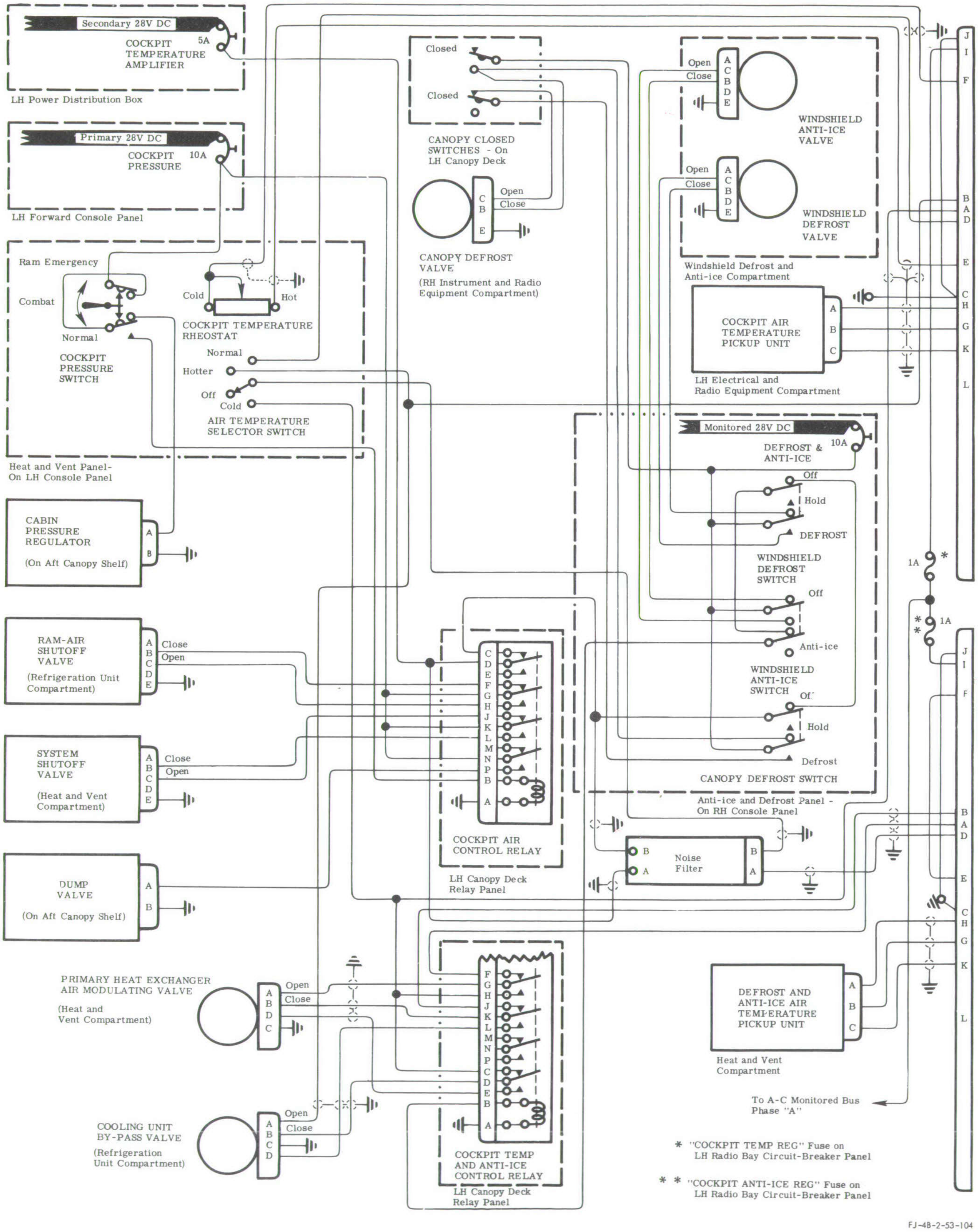
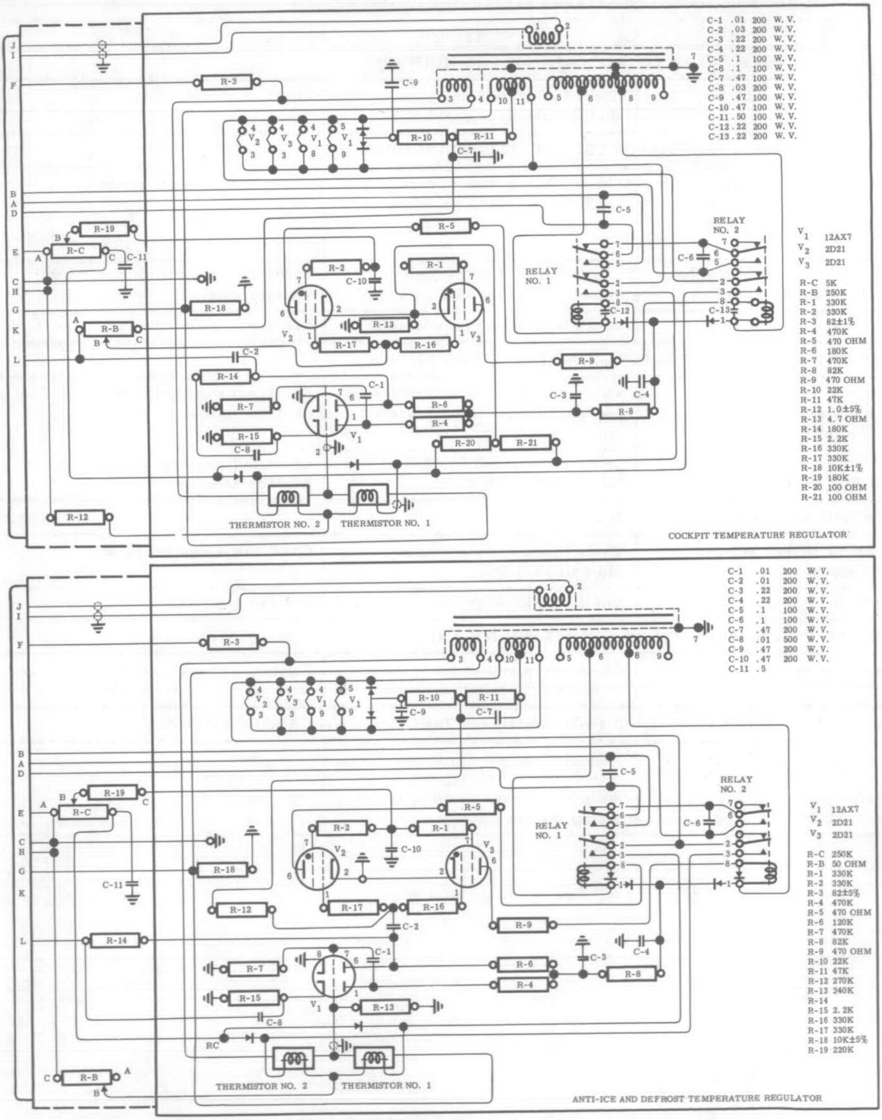


Figure No. 4-13. Cockpit Air Temperature Control System—Electrical Schematic (Sheet 1)



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Figure No. 4-13. Cockpit Air Temperature Control System—Electrical Schematic (Sheet 2)

4-5. TROUBLE SHOOTING COCKPIT AIR CONDITIONING SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
SUPPLY AIR NOT AVAILABLE FOR COCKPIT AIR CONDITIONING.		
Defective system shutoff valve.	Check air conditioning system shutoff valve (paragraph 4-11).	Check electrical circuit. Replace valve.
COOLED AIR NOT AVAILABLE FOR COCKPIT AIR CONDITIONING.		
Primary heat exchanger cooling-air modulating valve stuck in closed position.	Check primary heat exchanger cooling-air modulating valve (paragraph 4-32).	Check out electrical circuit. Replace valve.
Cooling unit by-pass valve stuck in open position.	Check cooling unit by-pass valve (paragraph 4-38).	Check electrical circuit. Replace valve.
Cooling unit inoperative.	Check turbine unit for operation.	Replace turbine unit.
HEATED AIR NOT AVAILABLE FOR COCKPIT AIR CONDITIONING.		
Primary heat exchanger cooling-air modulating valve stuck in open position.	Check primary heat exchanger cooling-air modulating valve (paragraph 4-32).	Check out electrical circuit. Replace valve.
Cooling unit by-pass valve stuck in closed position.	Check cooling unit by-pass valve (paragraph 4-38).	Check out electrical circuit. Replace valve.
COCKPIT RAM AIR NOT AVAILABLE.		
Ram-air shutoff valve inoperative.	Check ram-air shutoff valve (paragraph 4-89).	Check out electrical circuit.
Ram-air duct clogged.	Check duct for obstruction.	Remove obstruction.
AIR VOLUME FROM COCKPIT AIR OUTLETS INSUFFICIENT.		
Loose clamp.	Check entire system for loose or improperly installed clamps.	Tighten to proper torque.
MOMENTARY BLAST OF HOT AIR (HOT FLASH) ON TAKE-OFF WITH CANOPY CLOSED.		
Equalization of air pressure through primary heat exchanger.	Normal condition due to the reverse flow of air through the primary heat exchanger during ground operation.	

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
COCKPIT TEMPERATURE FLUCTUATES.		
Cockpit temperature unit or cockpit air temperature regulator not functioning properly.	Check electrical circuit by positioning the COCKPIT AIR TEMPERATURE selector rheostat to "HOT" and then to "COLD." Observe operation of primary heat exchanger cooling-air modulating valve and cooling unit by-pass valve. If the valves operate, inspect the cockpit air temperature pickup unit by checking the circuit for correct resistance values. If the resistance values are correct (depending on temperature), check or replace cockpit air temperature control regulator. (Since the cockpit air temperature control regulator is very complex, it is recommended that the regulator be replaced and the check be made with a new unit.)	Replace air temperature pickup unit or cockpit air temperature control regulator.
Defective wire shielding.	Check wire shielding.	Replace defective wire shielding.

4-6. CHECKING COCKPIT AIR CONDITIONING SYSTEM.

The main system shutoff valve may be checked visually for operation by observing the indicator installed on the end of the actuator. The primary heat exchanger cooling air modulating valve and the air cooling unit by-pass valve may be checked visually for operation by observing the linkage between the barrel and the actuator to determine their position. To accomplish the preceding checks, it will be necessary to remove the heat and vent access door and the refrigeration unit access door. With electrical power supplied to the airplane, make the following checks:

Note Place the d-c power switch in the "OFF" position before servicing the airplane with 28-volt external power.

WINDSHIELD DEFROST, CANOPY DEFROST and WINDSHIELD ANTI-ICE switches must be in the "OFF" position during the following checks.

1 Position COCKPIT PRESSURE switch to "NORMAL" or "COMBAT." Main system shutoff valve should open; ram-air valve should close.

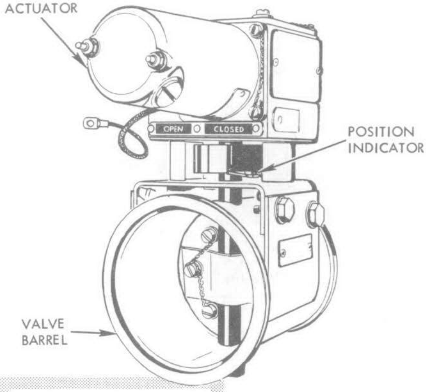
2 Position COCKPIT AIR TEMPERATURE control switch at "COLD" and AIR TEMPERATURE SELECTOR switch at "NORMAL." First, primary heat exchanger cooling air modulating valve should go full "OPEN"; then, the air cooling unit by-pass valve should close completely. (This sequence of operation is very important.)

3 Position COCKPIT AIR TEMPERATURE control switch to "HOT" and AIR TEMPERATURE SELECTOR switch to "NORMAL." First, air cooling unit by-pass valve should go full "OPEN"; then, primary heat exchanger cooling air modulating valve should close completely.

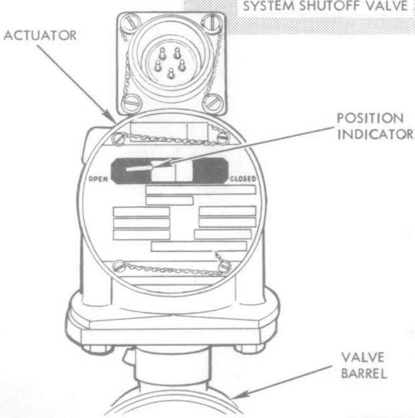
4 To verify proper operation, repeat steps 2 and 3.

5 Position cockpit AIR TEMPERATURE SELECTOR switch to "HOTTER." The air cooling unit by-pass valve should go full "OPEN" and the primary heat exchanger cooling-air modulating valve should fully close.

6 Position the cockpit AIR TEMPERATURE SELECTOR switch to "COLDER." The primary heat exchanger cooling-air modulating valve should open and the air cooling unit by-pass valve should close.

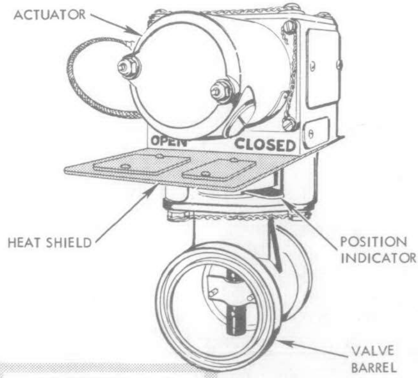


PRIMARY HEAT EXCHANGER MODULATING VALVE



SYSTEM SHUTOFF VALVE

FJ-4B-2-53-53



AIR COOLING UNIT BY-PASS VALVE

FJ-4B-2-53-54

4-7. CHECKING COCKPIT AIR CONDITIONING, DEFROST AND ANTI-ICE AND PRESSURIZING SYSTEMS WITH ENGINE OPERATING.

4-8. With the canopy open, test the cockpit air conditioning, defrost and anti-ice and pressurizing systems as follows:

a. Position WINDSHIELD DEFROST, CANOPY DEFROST and WINDSHIELD ANTI-ICE switches to "OFF."

b. Position COCKPIT PRESSURE control switch to "NORMAL" or "COMBAT."

c. Rotate COCKPIT AIR TEMPERATURE selector rheostat counterclockwise to "COLD" position.

d. Start engine and operate at 85 to 95% rpm.

e. Rotate COCKPIT AIR TEMPERATURE selector rheostat knob from "COLD" to "HOT"; then, reverse positions. This will cause the primary heat exchanger cooling-air modulating valve and air cooling unit by-pass valve to supply air at an increased or decreased temperature. Note temperature change by feeling outlet air which is discharged to the cockpit from the air outlets.

f. Position cockpit air temperature control switch at "HOTTER." The air cooling unit by-pass valve will open [movement can be checked visually (paragraph 4-6) or can be felt as the air at the cockpit air outlets becomes hotter] and the primary heat exchanger cooling-air modulating valve will close. Then, position the cockpit air temperature control switch at "COLDER" (the by-pass valve will close and the primary heat exchanger cooling-air modulating valve will open) and feel the cool air from the cockpit air outlets. Return cockpit air temperature control switch to "NORMAL."

g. Position COCKPIT PRESSURE control switch to "RAM EMER." Main system shutoff valve should close; ram-air valve should open (paragraph 4-6) and dump valve should open. (When the dump valve opens, there is an audible click from the dump valve solenoid.) Return COCKPIT PRESSURE control switch to "NORMAL."

h. Close canopy and position WINDSHIELD DEFROST switch to "WINDSHIELD DEFROST." Feel the air flowing from the windshield defrost air outlets and rotate the COCKPIT AIR TEMPERATURE control rheostat from "COLD" to "HOT"; note the same condition at the air outlets. If conditions of temperature regulation have not yet been stabilized, the primary heat exchanger cooling-air modulating valve may continue to modulate and control the air temperature to the windshield anti-ice system. Return the WINDSHIELD DEFROST switch to the "OFF" position.

i. Repeat step h., substituting the canopy defrost switch in place of the windshield defrost switch.

j. Open canopy and repeat step h., substituting the windshield anti-ice switch in place of the windshield defrost switch. Feel the air flowing from the anti-ice and rain removal nozzle. Shut down engine.

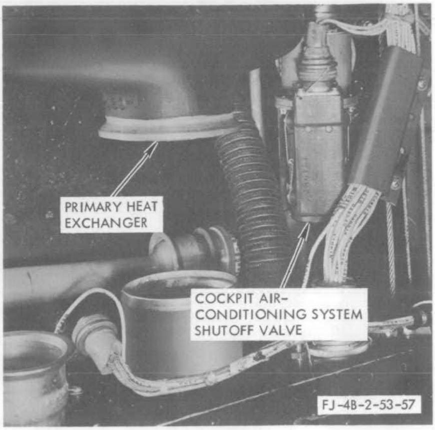


Figure No. 4-14. Cockpit Air Conditioning System Shutoff Valve

4-9. COCKPIT AIR CONDITIONING SYSTEM SHUTOFF VALVE.

4-10. The air conditioning system shutoff valve is attached to the downstream side of the primary heat exchanger outlet in the cockpit air conditioning duct. (See figure 4-14.) The valve is so situated that all the air for cockpit air conditioning can be shut off without interrupting the flow of air to the windshield anti-icing system, the windshield and canopy defrosting system or to systems that utilize air from the defrosting duct. (See figure 4-12.) When the COCKPIT PRESSURE control switch is placed at "RAM EMER," the valve closes; when the switch is placed at "COMBAT" or "NORMAL," the valve opens. The valve is powered by a 28-volt d-c actuator with an opening and closing time of 5 seconds. The valve is accessible through the heat and vent access door, aft of the canopy.

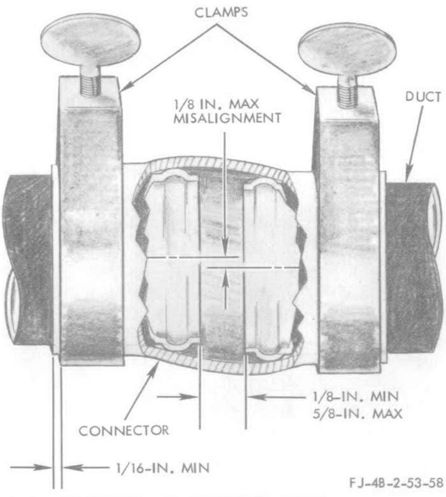
4-11. CHECKING COCKPIT AIR CONDITIONING SYSTEM SHUTOFF VALVE. To check the cockpit air conditioning system shutoff valve for proper functioning (with engine operating or using pressure test equipment), place the COCKPIT PRESSURE control switch at "RAM EMER" and the system shutoff valve should close. This can be determined by placing the hand near the cockpit air outlets at the same time the switch is positioned. Place the COCKPIT PRESSURE control switch at "COMBAT" or "NORMAL" position and the valve will open. The valve can be checked manually for proper operation by a visual indicator located on the end of the valve actuator. (Refer to paragraph 4-6.)

4-12. COCKPIT AIR OUTLETS.

4-13. The cockpit air is distributed by tubes which run lengthwise on each side of the pilot and contain a large number of small holes from which the air is directed. One set of tubes is routed to permit a discharge of air to the pilot's feet. Another set of tubes furnishes air for the pilot's leg and body area. This set of tubes may be rotated to obtain the desired airflow direction. A nozzle is also provided near the end of this set of tubes to further direct the airflow. (See figure 4-15.)

4-14. INSTALLING DUCTS, CONNECTORS AND CLAMPS.

When installing connectors (a hose between two duct sections), be sure the gap between the duct ends is 1/8-inch minimum and 5/8-inch maximum. When installing clamps on connectors, be sure the clamp is 1/16-inch minimum from end of the connector. Misalignment between ducts must not exceed 1/8-inch maximum.



4-15. COCKPIT AIR TEMPERATURE CONTROL SYSTEM.

4-16. The cockpit air temperature control system, remotely controlled from the cockpit, regulates the temperature of the air for cockpit air conditioning, windshield and canopy defrosting and windshield anti-icing. The system is controlled from the cockpit by a cockpit air temperature selector rheostat, a cockpit air temperature control switch, defrost control switches and an anti-ice control switch. The system also includes the following units: a cockpit air temperature control regulator, a cockpit air duct temperature pickup unit, a

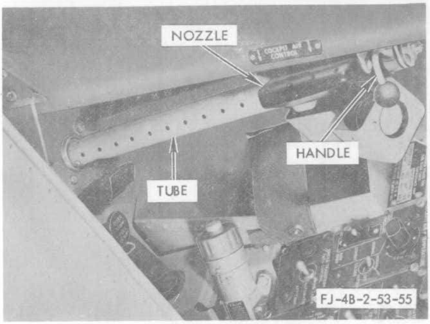
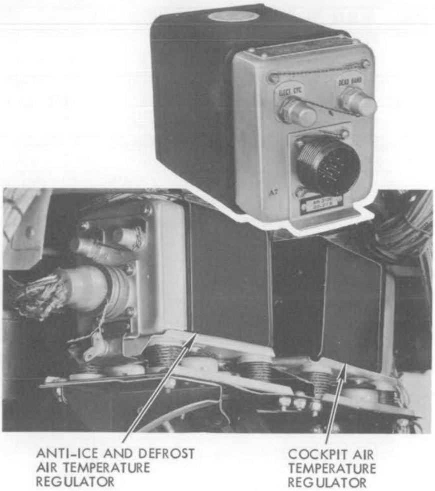


Figure No. 4-15. Cockpit Air Outlets

primary heat exchanger cooling-air modulating valve and an air cooling unit by-pass valve.

4-17. FUNCTION OF COCKPIT AIR TEMPERATURE CONTROL SYSTEM.

4-18. When the cockpit air temperature control switch is "OFF," air enters the cockpit at the temperatures corresponding to the position in which the cooling unit by-pass valve has stopped. When the cockpit air temperature control switch is in the "NORMAL" position and the CANOPY DEFROST and WINDSHIELD ANTI-ICE control switches are "OFF," the cockpit air temperature control regulator and the cockpit temperature pickup unit automatically control the flow of hot and/or cool air to the cockpit by properly positioning the air cooling unit by-pass valve and the primary heat exchanger cooling-air modulating valve. (Refer to paragraph 4-23 for function of the cockpit air temperature regulator.) When the cockpit air temperature control switch is placed at "COLDER," the primary heat exchanger cooling-air modulating valve turns to the full open position, after which the air cooling unit by-pass valve closes. This action routes all air to the cockpit through the cooling unit. Also, the cockpit air temperature and the anti-ice and defrost air temperature pickup units are electrically by-passed. When the cockpit air temperature control switch is placed at "HOTTER," the air cooling unit by-pass valve turns to the full open position, after which the primary heat exchanger cooling-air modulating valve closes so that the automatic temperature control units are by-passed and the hottest air possible is sent to the cockpit. Cockpit air temperature is controlled by the cockpit temperature control regulator when the cockpit air temperature control switch is in "NORMAL." If the WINDSHIELD ANTI-ICE switch is in the "WINDSHIELD ANTI-ICE" position, the anti-ice and defrost temperature control regulator will control the cockpit temperature. (See figure 4-13.)



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Figure No. 4-16. Cockpit Air Temperature Control Regulator

4-19. COCKPIT AIR TEMPERATURE SELECTOR RHEOSTAT.

4-20. The cockpit air temperature selector rheostat, located on the left-hand console (paragraph 4-78), permits selective temperature control by varying the effective temperature control point of the cockpit air temperature pickup unit. (Refer to paragraph 4-24.) The selector rheostat is labeled "COLD" and "HOT." No specific temperature division markings are stenciled on the control knob. The rheostat causes the cockpit temperature pickup unit to demand a specific supply air temperature and does not reflect the temperature that will exist in the cockpit at any given time.

4-21. COCKPIT AIR TEMPERATURE CONTROL REGULATOR.

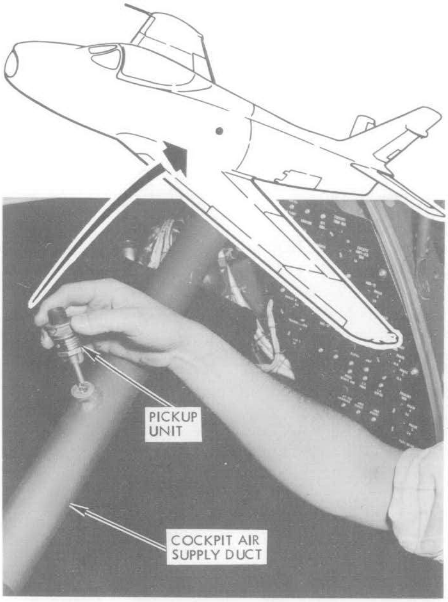
4-22. The cockpit air temperature control regulator (figure 4-16), in conjunction with the cockpit air temperature selector rheostat and the cockpit duct temperature pickup unit, automatically maintains the temperature of the air entering the cockpit at a preselected value. The regulator, located on the left side of the radio bay (station 156) below the aft end of the canopy, is an electronic device with a temperature regulating range (cockpit duct temperature) of −6.7°C to 135°C (20°F to 275°F). For internal wiring schematic of the cockpit air temperature control regulator, see figure 4-13.

4-23. FUNCTION OF COCKPIT AIR TEMPERATURE CONTROL REGULATOR. When the cockpit air temperature control switch is at "NORMAL," the cockpit air temperature control regulator functions as an electronic center for an a-c bridge circuit. One arm of the bridge is a fixed resistor in the regulator. The cockpit air conditioning system pickup unit (paragraph 4-24) serves as the second and third arms of the bridge and the cockpit air temperature selector rheostat (paragraph 4-19) completes the bridge circuit. When the temperature changes (affecting the pickup unit) or the rheostat is repositioned, an unbalanced condition is created in the bridge circuit. Signals from this unbalanced condition are converted into command signals which energize either a hot or a cool relay in the regulator. Then, the hot or cool relay (which receives 28-volt direct current when the cockpit air temperature control switch is in the "NORMAL" position) automatically controls the position of the cooling unit by-pass valve and the primary heat exchanger cooling-air modulating valve. With the cockpit air temperature control switch at "NORMAL," the sequence of operation of the cooling unit by-pass valve and the primary heat exchanger cooling-air modulating valve is the same as when the switch is at "HOTTER" or "COLDER."

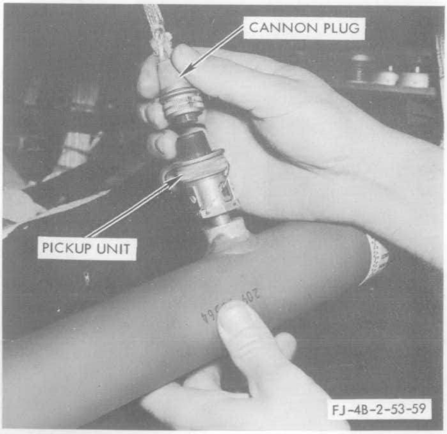
4-24. COCKPIT AIR TEMPERATURE SYSTEM PICKUP UNIT.

4-25. The cockpit air conditioning system pickup unit serves as the temperature sensing unit of the cockpit air temperature control system. This unit consists of a highly temperature-sensitive resistor and an adjustable resistor used to set the temperature control range of the unit. The air conditioning system pickup unit is located in the cockpit air supply duct in the upper left side of the radio compartment.

4-26. REMOVING AND INSTALLING COCKPIT AIR TEMPERATURE SYSTEM PICKUP UNIT.



Caution Do not overtighten pickup unit. Tighten finger-tight plus one-half turn.



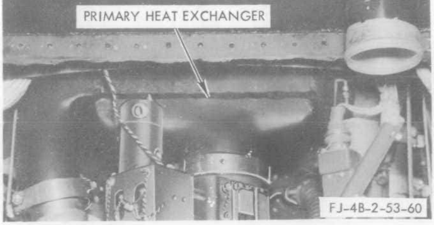
4-27. AIR COOLING SYSTEM PRIMARY HEAT EXCHANGER.

4-28. The primary heat exchanger, located slightly aft of the canopy and accessible through the heat and vent access door, receives air directly from the engine compressor and reduces the temperature by routing the air through the veins in the core of the heat exchanger. During flight, the core of the heat exchanger is cooled by ram air from the engine air intake duct, exhausting the air outside the airplane just aft of the heat and vent access door. On the ground (with engine running), the cooling airflow for the primary heat exchanger will be reversed because of the suction of the engine. (See figure 4-12.) The volume of ram air is regulated by the cooling-air modulating valve in the heat exchanger cooling-air discharge duct.

4-29. REMOVING AND INSTALLING AIR COOLING SYSTEM PRIMARY HEAT EXCHANGER.

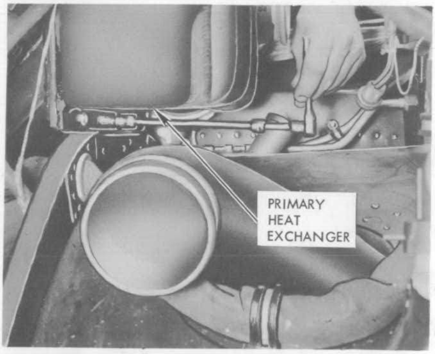
REMOVING

1. Remove battery compartment access cover.
2. Remove battery jar and battery.
3. Remove fuel vent line on right side of battery compartment.
4. Remove access panel from bottom of battery compartment.
5. Disconnect Cannon plug and bonding wire to cooling-air modulating valve.
6. Loosen hose clamps and slide hose to aft outlet duct flange. Loosen and remove front clamp from cooling air modulating valve and primary heat exchanger and remove valve.
7. Disconnect hot air duct to primary heat exchanger by removing clamp. Then slide air duct aft if engine is removed; if engine is not removed, disconnect air duct in aft section.
8. Disconnect and remove clamp between manifold assembly and primary heat exchanger.
9. Remove four bolts and lift out primary heat exchanger.

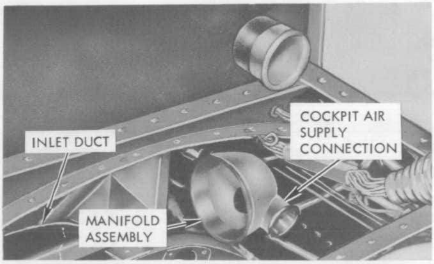


INSTALLING

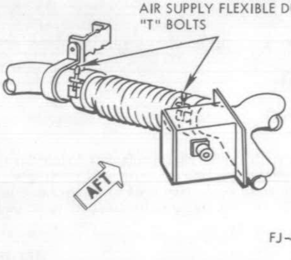
1 Ensure that gasket is securely cemented to heat exchanger forward flange; then secure to inlet duct with four bolts. Torque bolts from 25 to 50 inch-pounds.



2 Position manifold assembly to primary heat exchanger and install both halves of split "V" clamp. Slip alignment ring over clamp halves and install Marman band clamp. Torque "V" band clamps from 25 to 40 inch-pounds.



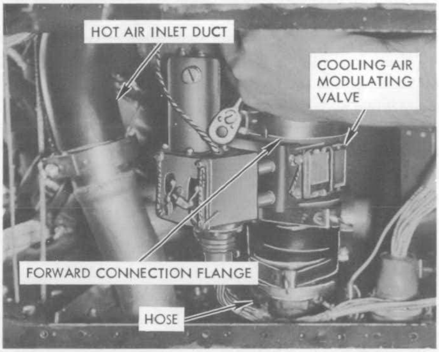
Note When installing the flexible duct in the air supply duct to the secondary heat exchanger, position the clamp "T" bolts on forward side of duct. This will eliminate possible contact of duct clamps with the fire detectors.



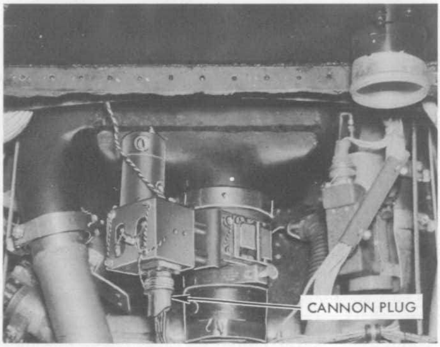
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3 Connect hot air inlet duct to primary heat exchanger with clamp, being sure "O" ring is correctly installed.

4 Install cooling air modulating valve by slipping (at the same time turning) hose on aft outlet duct; slip hose clamps over hose loosely. Be sure to install "O" ring in forward connection flange, position in place and install forward clamp. Slip hose on aft flange; position and tighten hose clamps.



5 Connect Cannon plug and bonding wire to cooling air modulating valve.



6 Replace access panel.

7 Install fuel vent line on right side of battery compartment.

8 Install battery and battery jar. (Refer to paragraph 8-27.)

9 Install battery compartment access cover.

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4-30. PRIMARY HEAT EXCHANGER COOLING-AIR MODULATING VALVE.

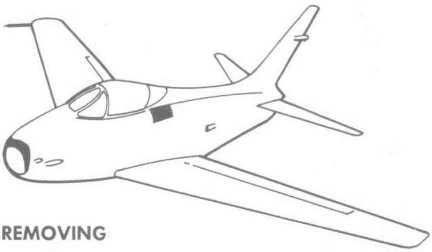
4-31. The primary heat exchanger cooling-air modulating valve (figure 4-17), located in the heat exchanger cooling-air discharge duct, serves to increase or decrease the amount of cooling air that passes through the heat exchanger. (See figure 4-11.) This valve is closed when full hot air is demanded by the temperature control regulator, provided the anti-ice and defrost systems are not operating. (Refer to paragraph 4-1.) The modulating valve, which is operated by an electric actuator, has an opening and closing time of 7 to 10 seconds. It is secured to the ducting by hose clamps at the aft end and by a Marman clamp on the forward side. It is accessible through the cover plate in the bottom of the battery compartment.

4-32. CHECKING PRIMARY HEAT EXCHANGER COOLING-AIR MODULATING VALVE. To check the modulating valve for proper function (with engine operating or using pressure test equipment), turn anti-ice and defrost systems off, place the cockpit air temperature control switch at "HOTTER" and observe that the valve shuts off the airflow through the primary heat exchanger cooling-air discharge duct. To check the valve for open position, place the cockpit air temperature control switch at "COLDER" and observe the free flow of air through the duct. This discharge duct is located on top of the airplane just aft of the heat and vent access door. This valve can also be checked visually for proper operation by observing the indicator on the valve shaft. (Refer to paragraph 4-6.)

4-33. AIR COOLING SYSTEM REFRIGERATION UNIT.

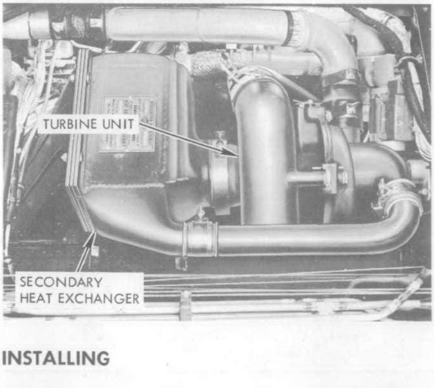
4-34. The cooling unit is composed of an air-to-air (secondary) heat exchanger and an air-driven expansion turbine. The secondary heat exchanger functions similarly to the primary heat exchanger except no control of the ram air for cooling the core obtained from the engine air inlet duct is provided (figure 4-12). The cooling unit by-pass valve controls the amount of air flowing to the secondary heat exchanger from the primary heat exchanger for further cooling. The ram air used as the coolant in the secondary heat exchanger is drawn through the secondary heat exchanger by the turbine-driven fan and is exhausted back into the engine air inlet duct. The fan is an integral part of the expansion turbine unit. The turbine is driven by air coming through the secondary heat exchanger from the primary heat exchanger. As air goes through the turbine, a large portion of its energy is absorbed in turning the turbine and fan. This absorption of energy plus expansion and pressure reduction results in a reduction in air temperature.

4-35. REMOVING AND INSTALLING AIR COOLING SYSTEM REFRIGERATION UNIT.



REMOVING

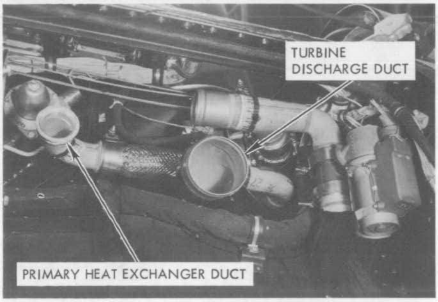
1. Remove cooling unit access door.
2. Remove duct between turbine and heat exchanger by removing two clamps.
3. Remove section of cold air duct between turbine and cockpit air duct connection above secondary heat exchanger.
4. Remove two bolts in supporting clamp at aft end of turbine and remove clamp.
5. Remove retaining clamp between turbine unit and secondary heat exchanger and lift out turbine unit.
6. Remove duct between primary heat exchanger duct and secondary heat exchanger.



INSTALLING

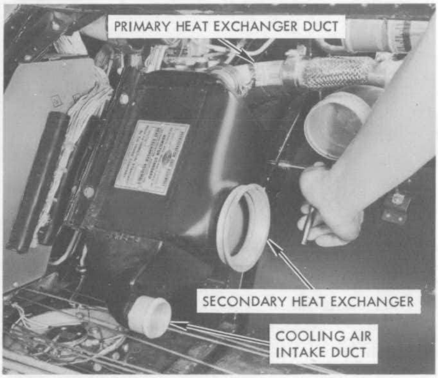
1. Secure cooling unit heat exchanger (secondary heat exchanger) to cooling air inlet duct making sure gasket is cemented to secondary heat exchanger and installed properly. Torque retaining bolts from 25 to 50 inch-pounds.

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2 Connect duct between primary heat exchanger and secondary heat exchanger being sure to install "O" ring. Install and tighten clamp.

Note Torque all clamps per torque chart in figure 4-8.



3 Check to see that grease cartridge is installed in expansion unit turbine.

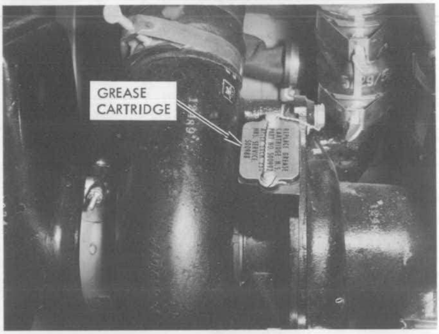
Note Check grease cartridge to see that cork seal is removed, felt wick is extended 1/32 to 1/16 inch and that 1/16-inch vent hole has been pierced in top of cartridge.

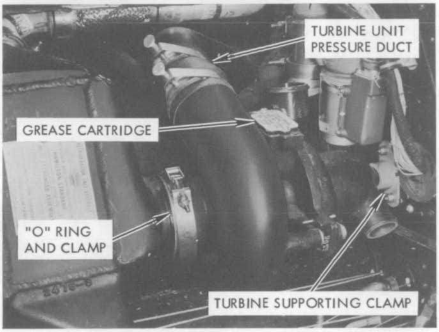
4 Be sure hose and hose clamp are on turbine discharge duct. Position expansion unit turbine by slipping hose from air discharge duct to turbine.

5 Install "O" ring and clamp at connection between secondary heat exchanger and expansion turbine unit.

6 Install two bolts in supporting clamp to anchor aft end of turbine.

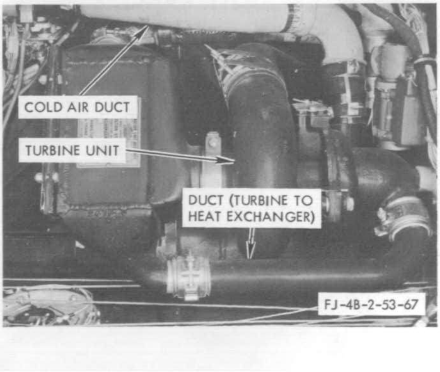
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7 Install section of cold air duct between turbine and cockpit air duct connection above secondary heat exchanger.

8 Install duct between turbine and heat exchanger with two clamps, being sure screen is installed in forward end of line at connection.



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4-36. AIR COOLING SYSTEM BY-PASS VALVE.

4-37. The cooling unit by-pass valve is an electrically operated shutoff valve. It is installed in the duct between the take-off to the cooling unit and the main cockpit air supply duct. Its purpose is to supplement the action of the primary heat exchanger cooling-air modulating valve by regulating the flow of air to the air cooling unit or by-passing it and directing the air to the cockpit. It is secured to the ducting by Marman-type clamps and is accessible through the heat and vent access door. The by-pass valve has an opening and closing time of 5 to 10 seconds.

4-38. CHECKING COCKPIT AIR COOLING UNIT BY-PASS VALVE. To check the air cooling unit by-pass valve for proper function (with engine operating or using pressure test equipment), turn anti-ice and defrost systems off and place the cockpit air temperature control switch at "COLDER." Feel the cool air by holding hand close to the cockpit air outlets. This will prove that the valve has closed. Place the cockpit air temperature control switch at "HOTTER" and feel the hot air flowing from the cockpit air outlets. This will prove that the valve has opened. The valve can be checked manually for proper operation by a visual indicator on the end of the valve actuator. (Refer to paragraph 4-6.)

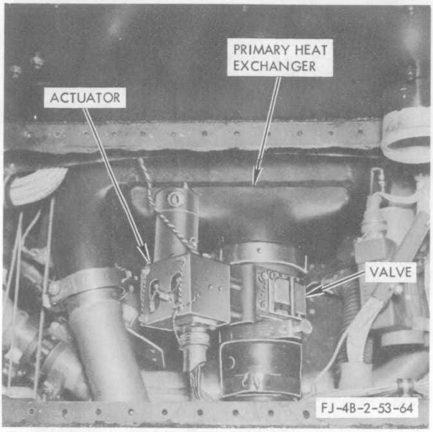


Figure No. 4-17. Primary Heat Exchanger Cooling-air Modulating Valve

DEFROSTING, ANTI-ICING AND RAIN REMOVAL SYSTEMS

4-39. DEFROSTING, ANTI-ICING AND RAIN REMOVAL SYSTEMS.

4-40. Provisions for windshield and canopy defrosting, windshield anti-icing and rain removal from the windshield are incorporated in the airplane. The source of air for defrosting, anti-icing and rain removal is the cockpit air conditioning system which is supplied from the engine compressor. This air is picked up through a manifold which is installed on the downstream side of the primary heat exchanger. (See figure 4-11.) Air is admitted to the defrosting, anti-icing and rain removal systems through a canopy defrost shutoff valve, a windshield defrost valve and a windshield anti-ice and rain removal valve (figure 4-18), all of which are controlled by switches located on the right-hand console. The temperature of the air is controlled by varying the amount of cooling air passing through the primary heat exchanger. Windshield anti-icing is accomplished by discharging heated air into the external boundary layer of the windshield. The heated air discharged from the windshield anti-ice nozzle also serves as the rain removal system.

4-41. FUNCTION OF DEFROSTING, ANTI-ICING AND RAIN REMOVAL SYSTEMS.

4-42. When the CANOPY DEFROST and WINDSHIELD DEFROST switches are held in the "DEFROST" positions, power is applied from the monitored bus to the open side of the canopy defrost and windshield defrost motor-operated valves. The energized valves open and admit air into the distribution outlets of the two systems.

Note

Either of these two control valves may be partially opened by positioning the valve's respective control switch to "DEFROST" and then quickly releasing the switch. (The switches will automatically return to the "HOLD" position.) These valves will move from fully closed to fully open in approximately 6 to 10 seconds.

When the WINDSHIELD ANTI-ICE switch is placed in the "ANTI-ICE" position, power will be applied from the monitored bus to the motor-operated valve which opens and admits air to the anti-icing duct. As the heated air is discharged from the windshield anti-icing nozzle, it serves two purposes: the rapidly moving blanket of warm air disperses rain by breaking the raindrops into small sizes which blow away; any moisture on the glass does not freeze because the same blanket of warm air heats the windshield glass to 0°C (32°F) or higher. A normally open, spring-loaded check valve is located in the rain-water drain line to prevent pressure loss when the windshield anti-icing system is in operation. When the valve is open, water which collects in the anti-icing air duct is dumped overboard on the right side of the airplane. This will take place when the system is not operating. The temperature of the air to the defrosting, anti-icing and rain removal systems is controlled by the defrost and anti-ice temperature regulator which operates in conjunction with a defrost and anti-ice air temperature pickup unit. An anti-ice thermoswitch completes the circuit to the windshield anti-icing overheat warning light when an overheat condition exists.

4-43. TROUBLE SHOOTING DEFROSTING, ANTI-ICING AND RAIN REMOVAL SYSTEMS.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
COLD AIR SUPPLY TO DEFROST AND ANTI-ICE SYSTEMS (CANOPY DEFROST AND WINDSHIELD DEFROST CONTROL SWITCHES IN "DEFROST" POSITIONS AND WINDSHIELD ANTI-ICE CONTROL SWITCH IN "ANTI-ICE" POSITION).		
Defective defrost and anti-ice temperature pickup unit.	Check pickup unit by installing a new pickup unit known to be satisfactory. (See figure 4-18.) Also check to see that connector to pickup unit is not broken or damaged.	Replace pickup unit.
Defective heat exchanger modulating valve.	Disconnect Cannon plug from valve and connect a positive 28-volt power source to pin "B" (positive) and ground to pin "C" (negative). Valve should close.	Replace valve.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
AIR NOT AVAILABLE TO WINDSHIELD DEFROST SYSTEM (WINDSHIELD DEFROST CONTROL SWITCH IN "DEFROST" POSITION).		
Defective windshield defrost valve.	Disconnect Cannon plug from valve and connect a positive 28-volt power source to pin "C" (positive) and ground to pin "E" (negative). Valve should open.	Replace valve.
Defective windshield defrost switch.	Check continuity.	Replace switch.
Open circuit between switch and windshield defrost valve.	Check continuity.	Repair or replace wiring.
NO AIR OR INSUFFICIENT AIR TO WINDSHIELD ANTI-ICING SYSTEM (WINDSHIELD ANTI-ICE CONTROL SWITCH IN "ANTI-ICE" POSITION).		
Defective windshield anti-ice valve.	Disconnect Cannon plug from valve and connect a positive 28-volt power source to pin "C" (positive) and ground to pin "E" (negative). Valve should open.	Replace valve.
Defective anti-ice switch.	Check continuity.	Replace switch.
Open circuit between switch and anti-ice valve.	Check continuity.	Repair or replace wiring.
Defective check valve in rain-water drain valve.	Check for leakage at drain valve outlet while testing system. (See figure 4-18.)	Replace check valve.
NO AIR TO CANOPY DEFROST SYSTEM (CANOPY DEFROST CONTROL SWITCH IN "DEFROST" POSITION WITH CANOPY CLOSED).		
Defective canopy defrost valve.	Disconnect Cannon plug from valve and connect a positive 28-volt power source to pin "C" (positive) and ground to pin "E" (negative). Valve should open.	Replace valve.
Defective canopy defrost switch.	Check continuity.	Replace switch.
Open circuit between switch and canopy defrost valve.	Check continuity.	Replace or repair wiring.
Canopy defrost depressurizing control microswitch defective or out of adjustment.	Check adjustment. (Refer to paragraph 4-100.)	Replace switch.
NO AIR OR INSUFFICIENT AIR TO RAIN REMOVAL SYSTEM (WINDSHIELD ANTI-ICE CONTROL SWITCH IN "ANTI-ICE" POSITION).		
Same as trouble NO AIR OR INSUFFICIENT AIR TO WINDSHIELD ANTI-ICING SYSTEM (WINDSHIELD ANTI-ICE CONTROL SWITCH IN "ANTI-ICE" POSITION).		

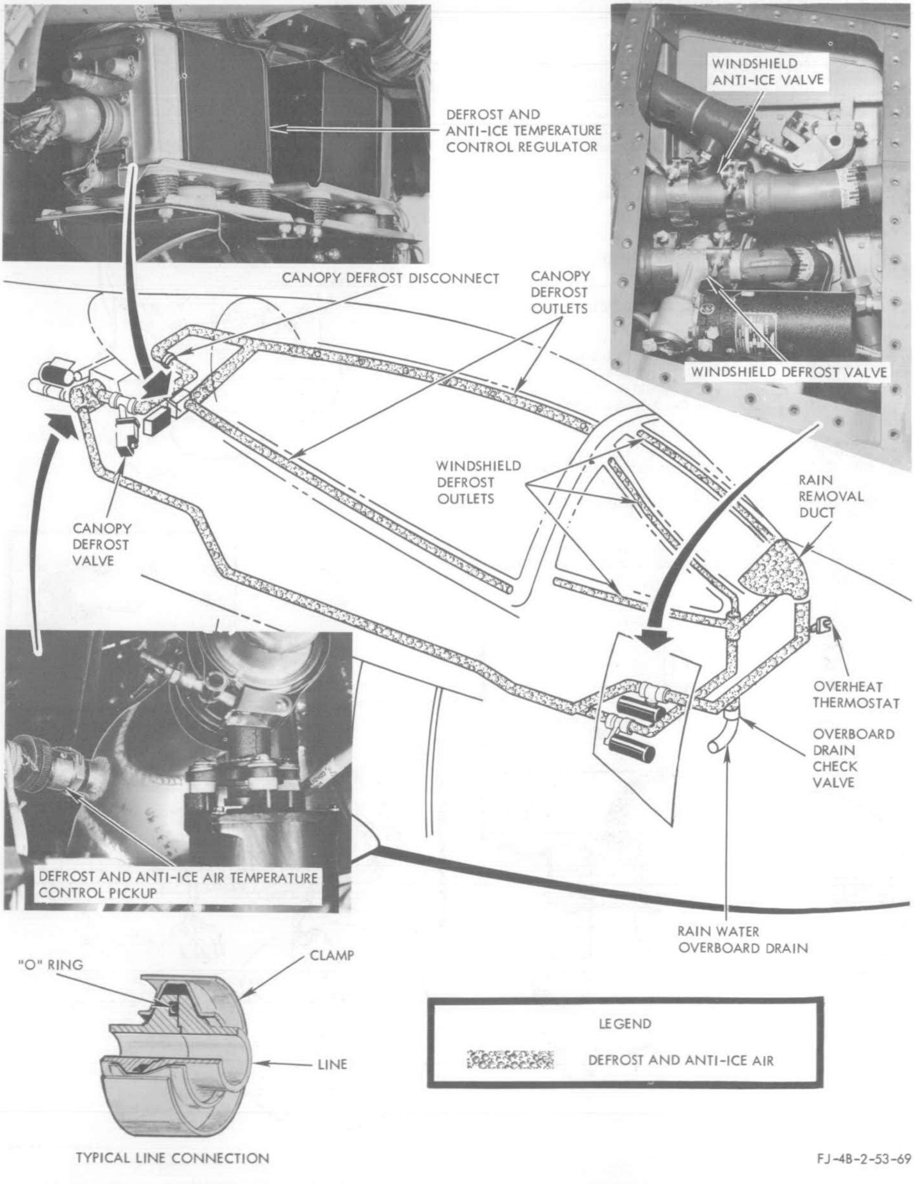


Figure No. 4-18. Defrosting, Anti-icing and Rain Removal Systems

4-44. CHECKING DEFROSTING, ANTI-ICING AND RAIN REMOVAL SYSTEMS.

Operation of the defrosting, anti-icing and rain removal system valves may be checked visually as shown below. To accomplish this check, it will be necessary to open the right-hand electrical and radio equipment access door and the brake cylinder and anti-ice access panel. With electrical power supplied to the airplane, make the following checks:

Note Place the d-c power switch in the "OFF" position while servicing the airplane with 28-volt external power.

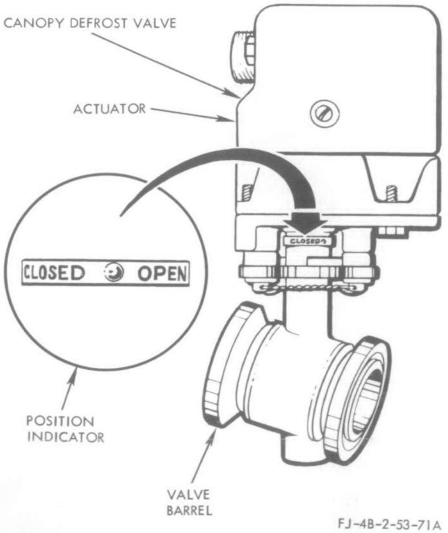
1 Position COCKPIT PRESSURE switch to either "NORMAL" or "COMBAT."

2 Position AIR TEMPERATURE SELECTOR switch to "NORMAL."

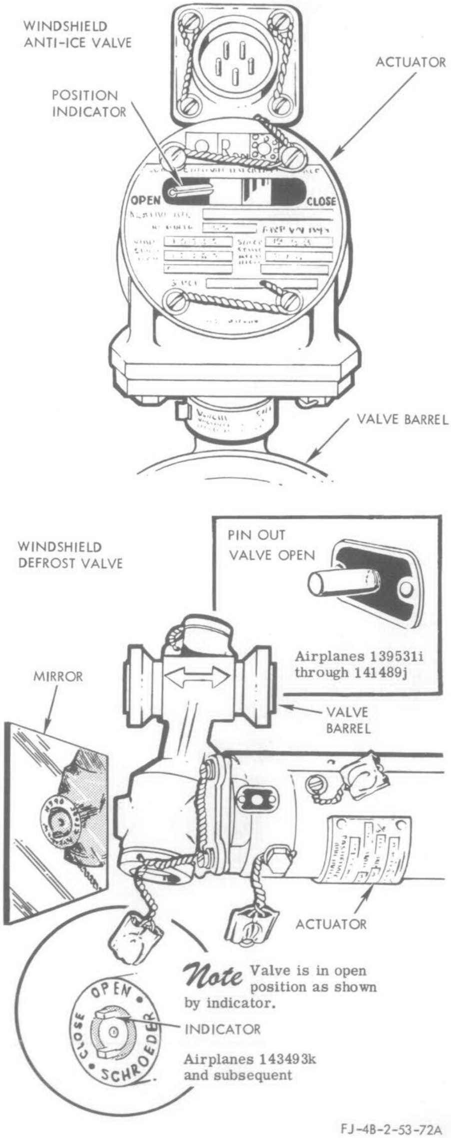
3 Position the CANOPY DEFROST switch to "DEFROST." Canopy defrost valve should open. Position switch to "OFF" and valve should close. ("HOLD" position should stop the valve at any desired position.)

4 Position WINDSHIELD DEFROST switch to "DEFROST." Windshield defrost valve should open. Position switch to "OFF" and valve should close. ("HOLD" position should stop the valve at any desired position.)

5 Position WINDSHIELD ANTI-ICE switch to "ANTI-ICE." Windshield anti-ice valve should open. Position switch to "OFF" and valve should close.



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4-45. DEFROST AND ANTI-ICE TEMPERATURE CONTROL REGULATOR.

4-46. The defrost and anti-ice temperature control regulator, in conjunction with the defrost and anti-ice air temperature pickup unit, maintains a temperature of 135 (±5.6)°C [275 (±10)°F] at the outlet of the primary heat exchanger during canopy and windshield defrosting and windshield anti-icing and rain removal. (See figure 4-18.) The regulator accomplishes this by controlling the primary heat exchanger modulating valve (paragraph 4-65) through the contacts of the cockpit temperature and anti-ice control relay (located on the bottom of the canopy deck and accessible through the radio and instrument compartment) when these contacts are in the de-energized position. The regulator is controlled by the defrost and anti-ice air temperature pickup unit. The regulator is located in the radio bay below the aft end of the canopy. The defrost and anti-ice temperature control regulator is adjusted by the manufacturer and no further adjustment is recommended.

4-47. DEFROST AND ANTI-ICE AIR TEMPERATURE PICKUP UNIT.

4-48. The defrost and anti-ice air temperature pickup unit, located in the defrost and anti-ice manifold at the primary heat exchanger (figure 4-18), is a sensing unit for the defrost and anti-ice temperature regulator. This unit is connected to the defrost and anti-ice temperature control regulator, which controls the primary heat exchanger modulating valve through the cockpit temperature and anti-ice control relay to an air temperature of 135°C (275°F).

4-49. CANOPY DEFROST VALVE.

4-50. The canopy defrost valve (figure 4-18), located slightly forward of the defrost and anti-ice manifold and accessible from the right-hand side of the radio bay, is a motor-operated valve which receives power from the monitored bus when the canopy defrost control microswitch is actuated (canopy closed) and the CANOPY DEFROST switch is the "DEFROST" or "OFF" position. The canopy defrost switch is a three-position switch: "DEFROST" position opens the valve, provided the switch is held in the "DEFROST" position (the switch automatically returns to the "HOLD" position when released from this position only), "OFF" position closes the valve and "HOLD" position stops the valve at any position between open and closed. When the canopy is opened, the safety switch automatically disconnects the CANOPY DEFROST switch and energizes the canopy defrost valve to the closed position. The valve can be checked for proper operation by a visual indicator located on the valve actuator. (Refer to paragraph 4-44.) The canopy defrost valve is accessible through the aft radio compartment access door on the right-hand side of the airplane. With the CANOPY DEFROST switch held in the "DEFROST" position (canopy closed), the valve opens and admits air into the canopy defrost ducting from the engine compressor bleed line. With the switch "OFF" (canopy closed), the valve closes and no air is available for canopy defrosting.



Figure No. 4-19. Defrost and Anti-ice Air Temperature Pickup Unit

4-51. CHECKING CANOPY DEFROST VALVE. To check the canopy defrost valve for proper functioning (with engine operating or using pressure test equipment and providing external power), close the canopy and place the CANOPY DEFROST switch in the "DEFROST" position. Feel the air flowing from the canopy defrost outlets. Position the CANOPY DEFROST switch to "OFF" and observe that no air flows from the canopy defrost outlets. Check that varied amounts of airflow are available by positioning the switch to "DEFROST" and back to "HOLD" in one to 2 seconds. The valve may be checked manually for proper operation by observing the visual indicator on the valve shaft between the actuator and the valve. (Refer to paragraph 4-44.)

4-52. WINDSHIELD DEFROST VALVE.

4-53. The windshield defrost valve is a motor-operated valve which receives power from the monitored bus when the WINDSHIELD DEFROST switch is in "DEFROST," provided the switch is held in the "DEFROST" position (the switch automatically returns to "HOLD" position when released from this position only) or the "OFF" position. The windshield defrost switch is a three-position switch: "DEFROST" position opens the valve, "OFF" position closes the valve and "HOLD" position stops the valve at any position between open and closed. The valve can be checked for proper operation by a visual indicator located on the end of the actuator (paragraph 4-44). The valve is accessible through the brake cylinder access door on the right-hand side of the forward fuselage (figure 4-18). With the switch held in the "DEFROST" position, the valve opens and admits air into the windshield defrost ducting from the engine compressor bleed line. With the switch "OFF," the valve closes and no air is available for windshield defrosting.

4-54. CHECKING WINDSHIELD DEFROST VALVE. To check the windshield defrost valve for proper functioning (with engine operating or using pressure test equipment and providing external power), place the

WINDSHIELD DEFROST switch in the "DEFROST" position and feel the flow of air from the windshield defrost outlets. Position the WINDSHIELD DEFROST switch to "OFF" and observe that no airflow exists. Position the switch from "DEFROST" to "HOLD" within one to 2 seconds and observe the varied amount of airflow; repeat this procedure until windshield defrost valve is fully opened. The windshield defrost valve may be checked manually for proper operation by visually checking the pin protruding from the valve end of the actuator when the valve is open. (Refer to paragraph 4-44.)

4-55. REMOVING AND INSTALLING WINDSHIELD DEFROST VALVE.

REMOVING

1 Remove brake cylinder and anti-icing access panel.

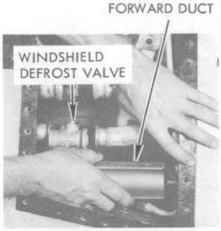
2 Remove two valve retaining clamps.

3 Pull forward duct slightly forward and lift out valve; be sure not to damage "O" rings and "O" ring seats.

4 Pull valve approximately 6 inches outward and disconnect Cannon plug.

INSTALLING

1 Connect Cannon plug while holding valve approximately 6 inches from installation point. Safety with AN995F32 lockwire.

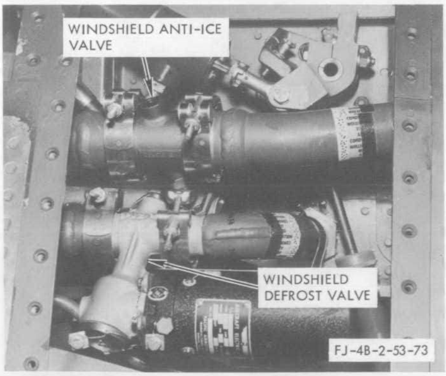


2 Apply slight forward pressure on forward duct, being sure to install "O" rings properly. Position into place, being careful not to damage "O" ring seats.

3 Install two valve retaining clamps.

4 Install windshield anti-ice valve.

5 Install brake cylinder and anti-ice access panel.



4-56. CANOPY AND WINDSHIELD DEFROSTING OUTLETS.

4-57. The outlets for the canopy defrosting system are located on each side of the canopy and extend parallel to the lower edges of the canopy. (See figure 4-20.) The two outlets are formed as an integral part of the canopy structure. Each outlet has holes spaced to give uniform airflow for defrosting the canopy. Defrosting of the windshield is accomplished by two outlets adjacent to each of the two outboard windshield panels. The lower outlet on each of these panels has holes to direct airflow up and across the outboard panels. Each of the upper outlets directs airflow across the center windshield panel and down across the outboard panels.

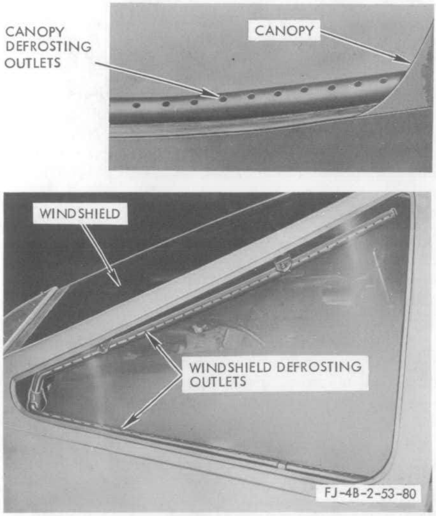


Figure No. 4-20. Canopy and Windshield Defrosting Outlets

4-58. WINDSHIELD ANTI-ICE AND RAIN REMOVAL NOZZLE.

4-59. The windshield anti-ice and rain removal nozzle, located at the base of the windshield, is incorporated in the system to provide proper disbursing of hot air to the front windshield and left side windshield. This unit consists of a funnel duct with a louver strip, installed in the top, which contains a series of small holes to direct the hot air into the external boundary area of the windshield.

4-60. REMOVING AND INSTALLING ANTI-ICE AND RAIN REMOVAL NOZZLE.

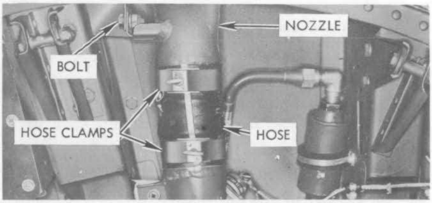
For removal, reverse sequence of installation procedure.

INSTALLING

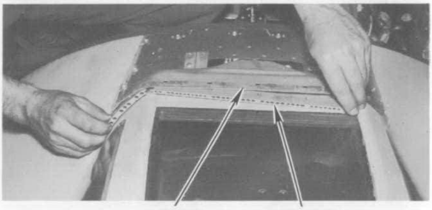
1 Position nozzle at base of windshield and twist from side to side to push base of nozzle into hose.

2 Install bolt in bracket near bottom of nozzle.

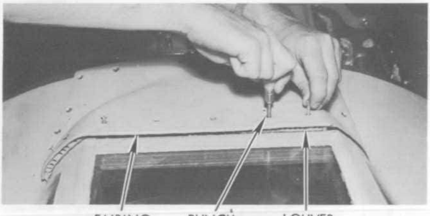
3 Install hose clamps at bottom of nozzle.



4 Position nozzle fairing in place and insert louver strips inside of nozzle top.



5 Line holes up with punch and install screws.



6 Install nose section access door.

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4-61. WINDSHIELD ANTI-ICING OVERHEAT WARNING LIGHT.

4-62. Since it is possible the windshield may crack if overheated during anti-icing, a windshield anti-icing overheat warning light is provided on the main instrument panel. This light will illuminate whenever the supply air temperature exceeds 149°C (300°F). Actuation of the warning light may be caused by malfunction of the automatic temperature control system. Actuation may also occur when windshield anti-icing and defrosting and canopy defrosting are all used at the same time at high airplane speeds at low altitude on relatively warm days. Under these conditions, it is possible for the windshield air temperature to exceed the 135°C (275°F) control temperature even though the primary heat exchanger cooling-air modulating valve is full open. (See figure 4-21.)



Figure No. 4-21. Windshield Anti-icing Overheat Warning Light

4-63. ANTI-ICE THERMOSWITCH.

4-64. The anti-ice thermoswitch is located in the windshield anti-icing ducting adjacent to the anti-ice and rain removal nozzle (figure 4-22). The function of this switch is to complete the circuit to the windshield anti-icing overheat warning light when an overheat condition exists [149°C (300°F)].

4-65. PRIMARY HEAT EXCHANGER COOLING-AIR MODULATING VALVE.

4-66. The primary heat exchanger cooling-air modulating valve is located in the cooling-air outlet ducting of the primary heat exchanger. (See figure 4-11.) The function of the modulating valve is to vary the amount of cooling air passing through the heat exchanger. It is positioned by the defrost and anti-ice control regulator (or the cockpit temperature control regulator if the anti-ice and defrost system is not operating) to maintain anti-icing and defrosting air temperature at 135°C (275°F). If the supply air temperature falls below 135°C (275°F), the defrost and anti-ice air temperature pickup sends a signal to the defrost and anti-ice control regulator. The control regulator, in turn, causes the modulating valve to

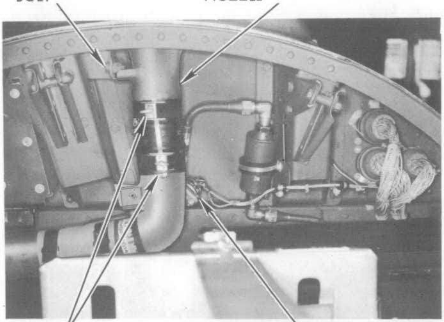


Figure No. 4-22. Anti-ice Thermoswitch

start to close [the degree of closure and how long the valve remains closed depends on the differential between the actual air temperature and 135°C (275°F)], allowing less cooling air to pass through the heat exchanger. By closing the modulating valve, the supply air temperature will increase to 135°C (275°F). Should the supply air temperature continue to rise above 135°C (275°F), the defrost and anti-ice air temperature pickup sends an opposite signal to the control regulator, which causes the modulating valve to open and allow more air to pass through the heat exchanger, resulting in cooling the supply to the required temperature of 135°C (275°F). This valve is accessible through the access panel in the bottom of the battery compartment.

4-67. WINDSHIELD ANTI-ICE VALVE.

4-68. The windshield anti-ice valve is a motor-operated valve which receives power from the monitored bus when the WINDSHIELD ANTI-ICE switch is in the "ANTI-ICE" or "OFF" position. When the valve is open, air is admitted into the windshield anti-icing ducting from the engine compressor bleed line. With the switch "OFF," the valve closes and no air is available for windshield anti-icing. The windshield anti-icing valve is accessible through the brake cylinder access door on the right side of the forward fuselage. The windshield anti-icing valve also serves as the rain removal shutoff valve. The two systems are one and the same as far as operation and component parts are concerned.

4-69. CHECKING WINDSHIELD ANTI-ICE VALVE. To check the windshield anti-ice valve for proper functioning (with engine operating, or using pressure test equipment and providing external power), place the WINDSHIELD ANTI-ICE switch in the "ANTI-ICE" position and feel the air flowing from the anti-ice and rain removal nozzle. Position the switch to "OFF" and observe that the airflow has stopped. The windshield anti-ice valve may be checked manually for proper operation by visually checking the indicator on the end of the valve actuator. (Refer to paragraph 4-44.)

4-70. REMOVING AND INSTALLING WINDSHIELD ANTI-ICE VALVE.

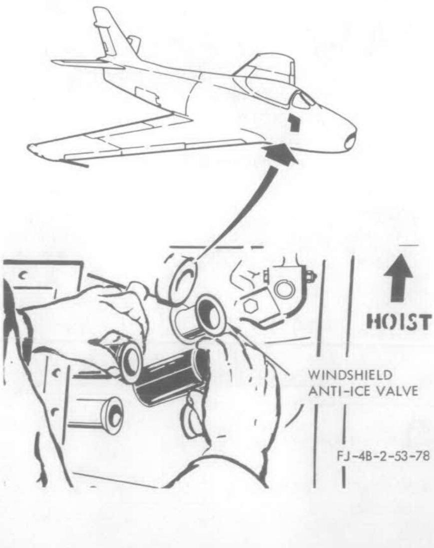
REMOVING

To remove windshield anti-ice valve, remove brake cylinder and anti-icing access panel and proceed as follows:

1. Remove windshield defrost valve. (Refer to paragraph 4-55.)
2. Loosen Adel clamp on duct on forward side of valve.
3. Remove two clamps from valve.
4. Pull forward on forward duct and lift out valve by positioning under defrost ducts. Be sure not to damage "O" rings or "O" ring seats.
5. With valve approximately 6 inches from duct, disconnect Cannon plug and remove valve.

INSTALLING

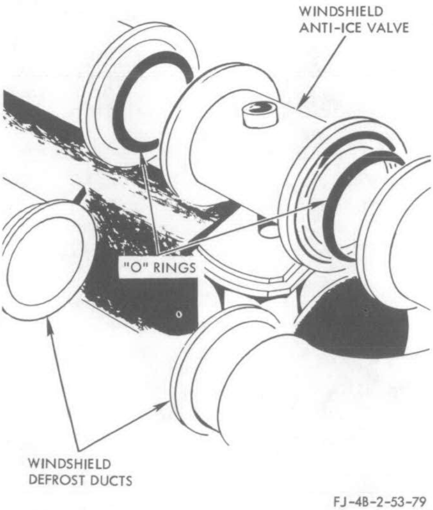
Note Torque all Marman clamps from 25 to 40 inch-pounds. Torque all National Utilities clamps from 15 to 30 inch-pounds (interchangeable with Marman clamps).



1 Hold valve approximately six inches from duct and connect Cannon plug. Safety Cannon plug with AN995F32 lockwire.

2 Slip valve under anti-ice duct and position in place with actuator motor aft and down, while holding forward pressure on forward duct. Be sure to insert "O" rings properly and not to damage "O" ring seats.

3 Install two clamps at valve.



COCKPIT PRESSURIZING SYSTEM

4-71. COCKPIT PRESSURIZING SYSTEM.

4-72. The cockpit pressurizing system (figure 4-23) provides control of the pressurized air, which is supplied to the cockpit by means of the air conditioning system ducts and air outlets, and is aided by the canopy and windshield defrost system ducts and air outlets. This air is derived from the thirteenth stage of the engine compressor. A cockpit air pressure regulator, located on the left-hand side of the canopy shelf, maintains either of two manually selected cockpit air pressure schedules. The first of these schedules (combat) consists of a nonpressurized cockpit from sea level to 10,000 feet, a constant 10,000-foot cockpit altitude from an airplane altitude of 10,000 to 18,000 feet and a 2.75 psi cockpit differential at all altitudes above 18,000 feet. The alternate schedule (normal) consists of a nonpressurized cockpit from sea level to 10,000 feet, a constant 10,000-foot cockpit altitude from an airplane altitude of 10,000 to 26,500 feet and a 5 psi cockpit differential at all altitudes above 26,500 feet. A cockpit pressure emergency dump valve is provided for cockpit pressure relief, vacuum relief and pressure dumping. A cockpit emergency ram-air valve is provided to supply the cockpit with ram air from the engine air intake duct in event the pressurization system becomes inoperative or contaminated.

4-73. FUNCTION OF COCKPIT PRESSURIZING SYSTEM.

4-74. When the COCKPIT PRESSURE control switch is positioned to "NORMAL," the solenoid valve in the pressure regulator is energized, closing the low-differential metering valve and allowing the high-differential metering valve to open and to provide an alternate air pressure schedule of 5 psi differential pressure (figure 4-11). With the COCKPIT PRESSURE control switch positioned to "COMBAT," the solenoid valve in the pressure regulator is de-energized, providing a low pressure which allows the high-differential metering valve to close and the low-differential metering valve to open and provide an air pressure schedule of 2.75 psi differential pressure. With the COCKPIT PRESSURE control switch positioned to "RAM EMER," the ram-air shutoff valve is opened, the system shutoff valve is closed and the cockpit emergency dump valve is opened, allowing ram air to flow through the cockpit from the engine intake duct. The regulator is actuated by the differential pressure existing between the ambient air (outside air) and the cockpit air and is completely automatic in its operation. A pressure tube connects the regulator control elements to the area of ambient pressure below the canopy deck. This connection establishes the correct relationship of ambient air pressures to cockpit differential pressures necessary for the internal mechanism to control the desired preselected schedule of cockpit pressure versus flight altitude.

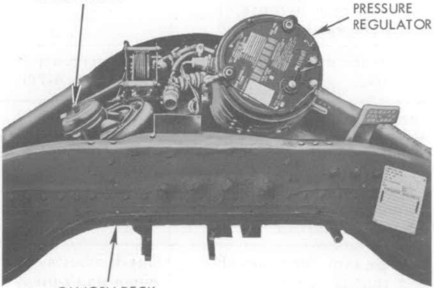


Figure No. 4-23. Cockpit Pressurizing System

4-75. TROUBLE SHOOTING COCKPIT PRESSURIZING SYSTEM.

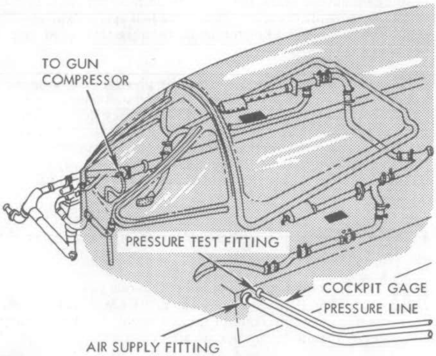
PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
COCKPIT AIR PRESSURE DIFFERENTIAL CANNOT BE CHANGED.		
Cockpit air pressure regulator inoperative.	Test cockpit air pressurizing system (paragraph 4-76). Check out electrical circuit.	Replace pressure regulator.
Cockpit pressure selector switch defective.	Check out electrical circuit.	Replace switch.
COCKPIT PRESSURE (ALTITUDE) NOT MAINTAINED OR FLUCTUATES.		
Leaks in cabin pressure sealing.	Test cockpit and duct pressures (paragraph 4-78).	Locate leaks and repair.
Canopy seal inoperative.	Test canopy seal (paragraph 4-98).	Replace seal. Replace canopy seal shutoff valve. Check out electrical circuit.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
COCKPIT PRESSURE (ALTITUDE) NOT MAINTAINED OR FLUCTUATES. (Cont)		
Canopy seal depressurization control microswitch defective.	Check adjustment of canopy seal depressurizing control microswitch (paragraph 4-100).	Check out electrical circuit. Adjust limit switches.
Faulty check valve.	Test canopy seal (paragraph 4-98).	Replace check valve.
Canopy seal pressure regulator defective.	Test canopy seal (paragraph 4-98).	Replace canopy seal pressure regulator.
Cockpit temperature control system malfunctioning.	Replace cockpit temperature control regulator. Replace temperature pickup unit.	
Canopy seal microswitch improperly adjusted.	Check adjustment of canopy seal microswitch (paragraph 4-101).	Adjust or replace microswitch.
Cockpit air pressure regulator inoperative.		Replace pressure regulator.
Emergency dump valve in dump position because of faulty electrical continuity.	Check out electrical circuit.	Replace cockpit pressure control switch.
Emergency dump valve defective.	Test emergency dump valve (paragraph 4-78).	Replace valve.
CANOPY SEAL INOPERATIVE.		
Seal ruptured.	Test canopy seal (paragraph 4-98).	Replace seal.
Canopy seal air pressure regulator defective.	Test canopy seal (paragraph 4-98).	Replace pressure regulator.
Canopy seal dump switch and canopy seal depressurizing control microswitches defective or adjusted incorrectly.	Check adjustment of canopy seal dump and canopy seal depressurizing control microswitches (paragraphs 4-100 and 4-101).	Check out electrical circuit. Replace switches.
COCKPIT AIR DUMP SYSTEM INOPERATIVE.		
Emergency dump valve solenoid damaged or inoperative.	Test emergency dump valve (paragraph 4-78).	Check out electrical circuit. Replace dump valve.
Dump valve diaphragm damaged or inoperative.	Check freedom of dump valve by manually depressing dump valve diaphragm.	Replace defective unit.

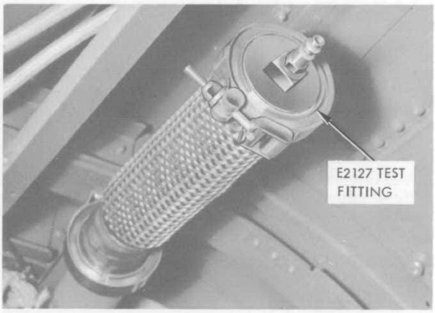
4-76. TESTING COCKPIT PRESSURIZING SYSTEM.

4-77. Prior to the initial pressurized flight, after any repair work to the pressurized surfaces of the cockpit, the cockpit must be checked for pressure-tightness. Ground pressurization for testing is accomplished by the introduction of air pressure from an external source into the cockpit through an air line connector fitting located in the left side of the cockpit pressure bulkhead. Access to the connector fitting is through the left gun bay access door. If rate-of-flow loss during pressure test exceeds 55 cfm (this value includes 5 cfm allowable pressure regulator leakage and 5 cfm refrigeration unit leakage), refer to paragraph 4-108 for repair method. For testing, refer to paragraph 4-78.

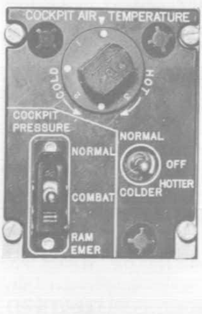
4-78. TESTING COCKPIT AND DUCT PRESSURES.



1 Disconnect aft end of engine disconnect flex connector and install E2127 test fitting.



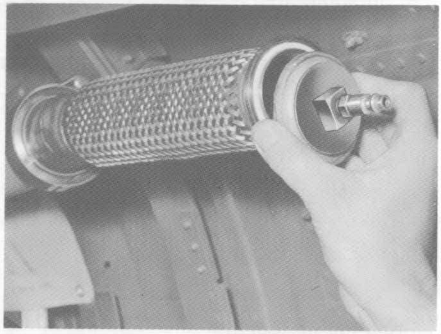
2 Disconnect and cap pressure lines to: gun charger compressor, hydraulic reservoir and canopy seal regulator, drop tank, anti-G suit and fuel dump line.



3 With electrical power on airplane, position cockpit pressure selector switch to "RAM EMER," and anti-ice and defrost control switches to "OFF."

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4 Connect external air pressure line to test fitting and apply a pressure of 115 psi. Check for leaks and make necessary repair.





5 Position CANOPY DEFROST switch to "DEFROST" and check airflow at canopy defrost outlets; then return switch to "OFF."

6 Position WINDSHIELD ANTI-ICE switch to "ANTI-ICE" and check airflow; then return switch to "OFF."

7 Position WINDSHIELD DEFROST switch to "DEFROST" and check airflow at outlets; then return switch to "OFF."

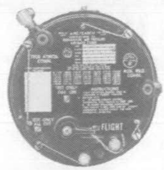
8 With external pressure removed, remake gun charger compressor connection, hydraulic reservoir and canopy seal regulator connection, drop tank, anti-G suit and fuel dump line connections.

9 Disconnect pressure line, remove test fitting E2127 and reconnect engine flex connector. Torque Marman "V" band clamp from 50 to 70 inch-pounds.

10 With electrical power connected to the airplane, position COCKPIT PRESSURE selector switch to "RAM EMER."

11 Disconnect system shutoff valve electrical connector.

12 Position COCKPIT PRESSURE selector switch to "NORMAL."

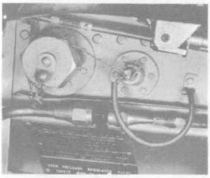


13 Move selector handle on pressure regulator 180 degrees counterclockwise to the "TEST ONLY ALL OFF" position.

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14 Connect air supply line to external pressurization fitting.

15 Connect cockpit gage pressure line to pressure test fitting.



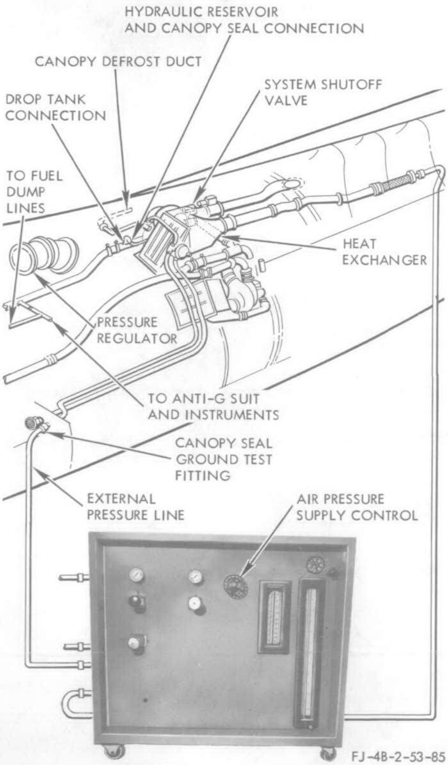


LH GUN BAY-AFT BULKHEAD

16 Connect pressure line to canopy seal ground test fitting.

17 Adjust pressure line to canopy seal to 25 psi.

18 Close canopy. Canopy seal should inflate.



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19 Slowly open air pressure supply control until cockpit pressure gage reads 5 psi. Maximum allowable reading on rate-of-flow indicator is 55 feet per minute allowable cockpit pressure regulator leakage. Rate-of-climb indicator should never indicate more than 1000 feet per minute.

20 Check dump valve operation by placing regulator in "TEST ONLY ALL OFF" position and check operation of pressure relief function of emergency dump valve. Increase cockpit test pressure until there is a 10.8 to 11.3 in. Hg differential between cockpit pressure and atmospheric pressure. This should cause the valve to operate. (Dump valve operation can be determined by an audible click.)

Caution Under no circumstances should the applied differential pressure exceed 11.7 in. Hg (5.75 psi).

21 Lower cockpit pressure slowly to one psi. Place COCKPIT PRESSURE switch at "RAM EMER," then energize pressurizing control circuit breaker. Emergency dump valve should dump cockpit air pressure.

Note On completion of this test, safety-wire pressure regulator in the "FLIGHT" position and connect system shutoff valve electrical connector.

22 Test canopy seal. (Refer to paragraph 4-98.)

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4-79. COCKPIT AIR PRESSURE REGULATOR.

4-80. The cockpit air pressure regulator, located on the left side of the canopy shelf, maintains cockpit pressure at a predetermined schedule by controlling the outflow of pressurized air from the cockpit. Excess air is relieved by the regulator through an outflow valve that discharges the air through the canopy deck to an area which is essentially at atmospheric pressure. High- and low-differential operation is manually controlled by the cockpit pressure selector switch located on the left console. A manually operated, three-position test valve, located on the forward end of the regulator, is used for ground pressure testing. During normal operation, the test valve handle is safetied in the "FLIGHT" position. For ground testing the differential pressure, the test valve handle is moved 90 degrees to the "TEST ONLY DIFF ON" position; for pressure testing the cockpit on the ground, the handle is moved 180 degrees to the "TEST ONLY ALL OFF" position. The four pressure adjustment screws, on the forward end of the regulator, are used for calibration adjustment at all stages of operation except the unpressurized stage. The adjustments are factory-set and any other necessary settings should be made with the proper bench-testing equipment. An internal filter excludes foreign material from the regulator. A screw cap, on the forward end of the regulator, holds the filter in place and can be removed to clean the filter. (Refer to paragraph 4-84.)

4-81. FUNCTION OF COCKPIT AIR PRESSURE REGULATOR.

4-82. When the test valve handle is in the "FLIGHT" position, the pressure regulator is in normal operation. During normal operation, the pressure regulator (figure 4-24)

controls cockpit pressure through five stages of operation: unpressurized, isobaric, low-differential, high-differential and pressure change-over. In the unpressurized range of operation, cockpit pressure is substantially the same as atmospheric pressure up to 10,000 feet, regardless of the position of the cockpit pressure selector switch. In the isobaric range, with the COCKPIT PRESSURE selector switch in the "COMBAT" position, cockpit pressure is maintained at a 10,000-foot altitude from 10,000 to 18,000 feet. In this range, with the COCKPIT PRESSURE selector switch at "NORMAL," cockpit pressure is maintained at a 10,000-foot altitude from 10,000 to 26,500 feet. In the low-differential range, with the COCKPIT PRESSURE selector switch in the "COMBAT" position, the differential between cockpit air pressure and atmospheric pressure is maintained at 2.75 psi at all altitudes above 18,000 feet. In the high-differential range, with the COCKPIT PRESSURE selector switch in the "NORMAL" position, the differential between cockpit air pressure and atmospheric pressure is maintained at 5 psi at all altitudes above 26,500 feet. During a change from low- to high-differential operation with the airplane in level flight, the rate of cockpit pressure increase is a maximum of 2 in. Hg per minute (approximately one psi per minute).

4-83. REMOVING AND INSTALLING COCKPIT AIR PRESSURE REGULATOR.

REMOVING

To remove cockpit air pressure regulator, remove canopy (paragraph 2-31) and place on a large table with forward end of canopy protruding over edge of table. This will provide convenient accessibility to the regulator. Proceed as follows:

A. Disconnect Cannon plug from regulator.

B. Disconnect flexible line from regulator.

C. Remove Marman clamp from base of regulator and lift out unit.

INSTALLING

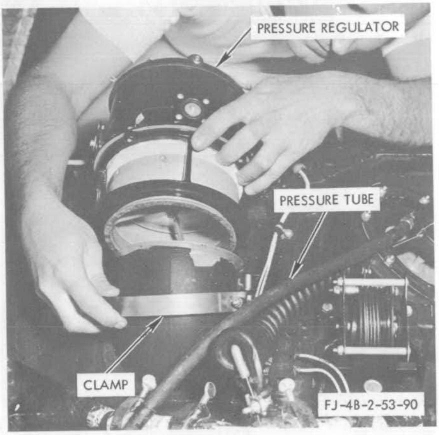
To install cockpit air pressure regulator, place canopy on a large table with forward end protruding over edge of table and proceed as follows:

A. Position regulator in place and secure with Marman clamp at base of regulator.

B. Connect flexible line.

C. Connect Cannon plug.

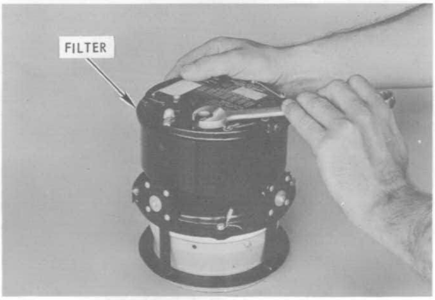
D. Install canopy. (Refer to paragraph 2-33.)



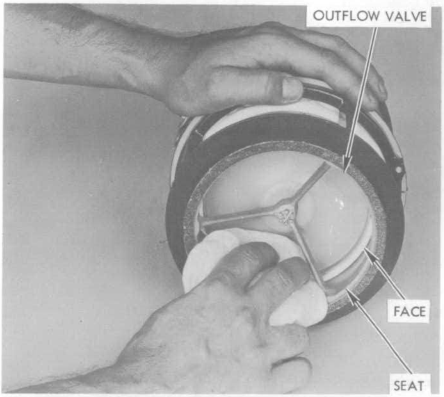
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4-84. CLEANING COCKPIT AIR PRESSURE REGULATOR.

Remove the filter assembly (located to the lower right of test valve handle on the face of the regulator) by cutting lockwire and unscrewing cap. Wash the filter and cap assembly in trichlorethylene (item 134, materials list) and dry with compressed air. Do not remove the copper ribbon. After cleaning, screw the filter and cap assembly to regulator and safety with AN995F32 lockwire.



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1 Push outflow valve upward and hold.

2 If inspection shows the presence of dirt or foreign material, clean outflow valve face and seat with a soft clean cloth.

Caution Do not clean valve face and seat with compressed air.

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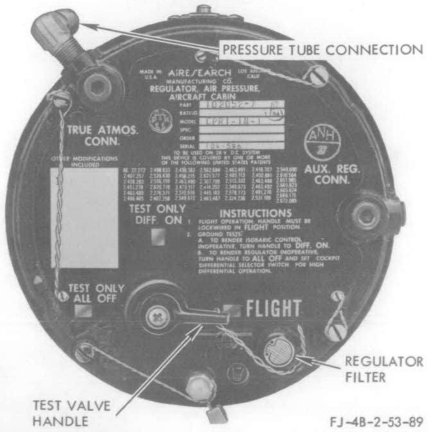
4-85. COCKPIT AIR PRESSURE EMERGENCY DUMP VALVE.

4-86. Cockpit pressure relief, vacuum (or negative pressure) relief and dumping are provided by one unit—the emergency dump valve on the right side of the canopy shelf (paragraph 4-78). Vacuum relief is automatic and consists of the pressure actuation of a poppet-type diaphragm valve which opens to equalize the internal-external cockpit pressures. The positive-pressure relief valve is set to operate at a differential of not more than 11.3 in. Hg or less than 10.8 in. Hg between cockpit air pressure and atmospheric pressure. The vacuum (or negative-pressure) relief valve setting is 0.5 in. Hg (maximum). Positive-pressure relief is required if the cockpit air pressure regulator fails and negative-pressure relief is required during a rapid airplane descent if the cockpit pressure falls below ambient pressure. The emergency dump feature of the valve serves to dump all cockpit air pressure whenever the COCKPIT PRESSURE control switch is moved to the "RAM EMER" position. This control, located in the control panel on the left console in the cockpit, dumps the pressure by energizing a solenoid valve in the air outlet line of the emergency dump valve.

4-87. COCKPIT RAM-AIR SHUTOFF VALVE.

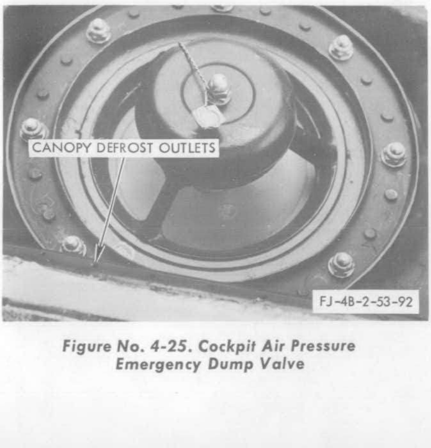
4-88. The cockpit ram-air shutoff valve (figure 4-11), located in the duct between the engine ram-air intake duct and the main cockpit air conditioning supply duct, is accessible through the air cooling unit access door on the left side of the fuselage. This shutoff valve provides control of the ram air which is used in event of air conditioning or pressurizing system failure. The valve is powered by a 28-volt d-c actuator with an opening and closing time of 5 seconds. The actuator is controlled by the "RAM EMER" position of the COCKPIT PRESSURE control switch on the left-hand console cockpit pressure control panel.

4-89. CHECKING RAM-AIR SHUTOFF VALVE. To check the ram-air shutoff valve for proper functioning (with engine operating or using pressure test equipment), place the COCKPIT PRESSURE control switch at "RAM EMER" and the ram-air shutoff valve should open. Place the COCKPIT PRESSURE control switch at "NORMAL" or "COMBAT" and the valve should close. The ram-air shutoff valve can be checked manually for proper operation by a visual indicator on the end of the valve actuator (paragraph 4-6).



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Figure No. 4-24. Cockpit Air Pressure Regulator



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Figure No. 4-25. Cockpit Air Pressure Emergency Dump Valve

COCKPIT AND CANOPY SEALING

4-90. COCKPIT AND CANOPY SEALING.

4-91. The pilot's compartment has been sealed during manufacture of the airplane to ensure proper operation of the cabin pressurization system. (See figures 4-26 and 4-28.) This sealing should not be disturbed unless repairs are necessary. Three sealing methods are used: rubber seals at all points where frequent breaking of the seal is necessary (such as canopy and access doors), sealing compounds at points where no breaking of the seal is expected, except for structural maintenance or part replacement (such as lap and butt joints of outer skins or bulkheads and drill or other holes in these areas) and special seals for passing cables, tubing, mechanical linkages and wiring through the bulkheads forming a part of the pressurized area.

4-92. CANOPY SEAL.

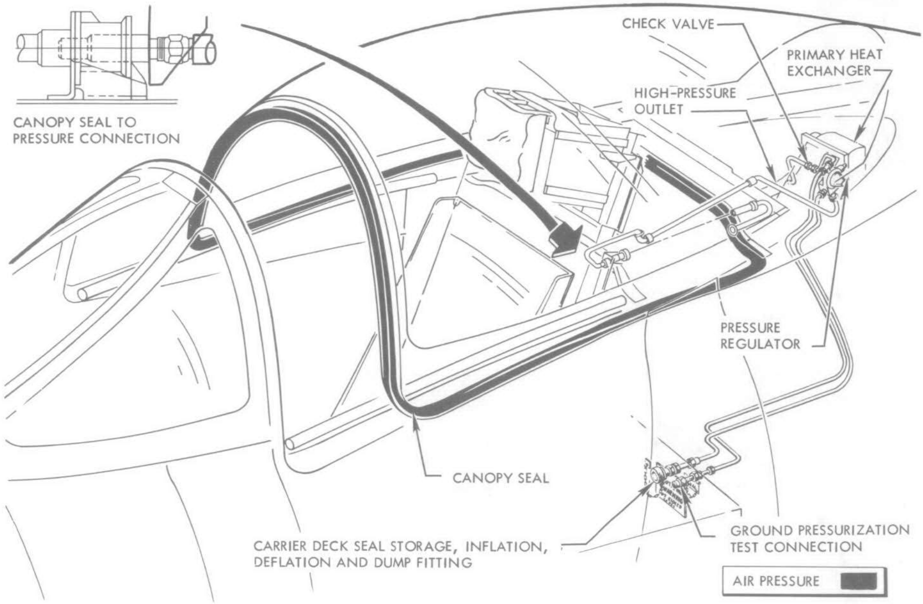
4-93. An inflatable canopy pressure seal system is installed (figure 4-26) to provide sealing between the canopy and fuselage. Air pressure for inflating the seal is taken from the windshield defrosting and anti-icing duct. An air pressure regulator maintains the proper pressure within the seal by combining the functions of a pressure regulator, relief valve and shutoff valve. A spring-loaded check valve is installed in the line between the high-pressure duct and the pressure regulator. This valve prevents pressure backing into the main air conditioning supply duct during ground testing of the canopy seal system; the valve also acts as an accumulator when engine pressure falls below seal pressure. A ground pressurization test fitting, installed in the left gun bay, is provided for testing purposes to pressurize the canopy seal on the ground. Another fitting, adjacent to the canopy seal ground pressurization test fitting, is provided so that the canopy seal can be pressurized for deck storage without electrical power on the airplane. This is accomplished with an external pressure bottle which is used during severe storm exposure on the carrier deck. This pressure must be controlled by a pressure regulator, adjusted to 15 psi maximum. The external pressure bottle must remain attached to the carrier deck seal storage, inflation, deflation and dump port to maintain pressure within the seal. When the bottle is removed, the pressure is dumped.

Note

The carrier deck seal storage, inflation, deflation and dump port has a small screen over the outlet which must be kept clean and free from obstructions.

4-94. FUNCTION OF CANOPY SEAL.

4-95. Power for operation of the pressure regulator is taken from the primary bus (figure 4-26). From the primary bus, power is routed through the canopy seal dump microswitch (located on a bracket on the right aft side of the pilot's headrest), the canopy seal depressurizing control microswitch (located on the armor plate on the aft side of the pilot's seat) and the canopy seal relay. An interruption of electrical current, either by the actuation of the CANOPY switch to "OPEN" or "CLOSE" or through electrical failure, will de-energize the pressure regulator solenoid valve, causing the valve to close and vent the air in the seal to permit opening of the canopy. Emergency depressurizing of the canopy seal is accomplished by a canopy seal dump microswitch. When the face curtain is extended approximately 7 inches, the emergency dump microswitch is actuated to the open position by linkage and the canopy seal pressure regulator solenoid is de-energized.



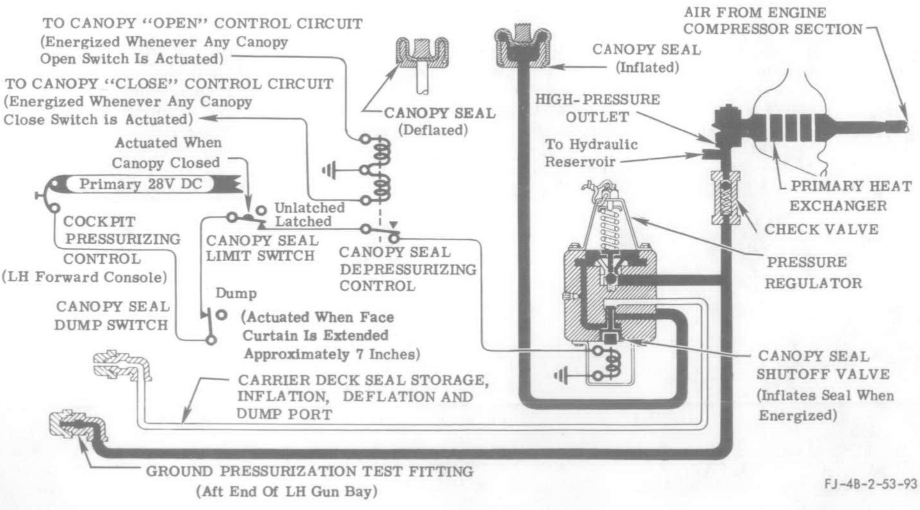


Figure No. 4-26. Canopy Seal

4-96. TROUBLE SHOOTING CANOPY SEAL.

TEST EQUIPMENT: D-C voltmeter.

SYSTEM CONDITIONS: Canopy open; maintain CANOPY LATCHED switch in "LATCHED" position.
COCKPIT PRESSURE circuit breaker engaged.
Airplane on ground.
28-volt d-c power applied to airplane.

WARNING

Do not move canopy.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
SEAL WILL NOT INFLATE DURING NORMAL OPERATION.			
Ruptured seal.	Test canopy seal. (Refer to paragraph 4-98.)	None.	Replace seal.
Defective pressure regulator.	Check test point MBA to ground.	28 volts dc.	Replace defective pressure regulator.
		Zero volts.	Continue trouble shooting procedure.
Improperly rigged or broken CANOPY LATCHED switch.	Check test point MBB to ground.	28 volts dc.	Replace defective latched switch or wire segment to pressure regulator.
		Zero volts.	Continue trouble shooting procedure.
Improperly rigged or broken canopy seal dump switch.	Check test point MBC to ground.	28 volts dc.	Replace defective dump switch or wire segment to latched switch.
		Zero volts.	Replace defective power wire.
CANOPY CONTROL SWITCH PLACED TO "OPEN"; SEAL DOES NOT DEFLATE.			
Defective canopy seal depressurizing control circuit.	Check test point MBD to ground.	28 volts dc.	Replace defective canopy seal depressurizing control relay.
		Zero volts.	Refer to paragraph 2-30, Trouble Shooting Normal Canopy Actuating System.
POWER FAILURE.			
Defective circuit breaker.	Check test point PDC to ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.
SEAL WILL NOT INFLATE DURING GROUND TEST.			
Defective check valve.	Test canopy seal. (Refer to paragraph 4-98.)	None.	Replace defective check valve.

4-97. WEATHERPROOFING CANOPY SEAL. To prolong the life of the inflatable canopy seal, a protective coat of weather-coating compound (item 36, materials list) should be applied to the surface of the seal. Whenever a section of the seal requires resurfacing, the defective area must first be cleaned with solvent (item 119, materials list); then, the weatherproofing compound may be applied by brush.

4-98. TESTING CANOPY SEAL. To test canopy seal, see figure 4-26. With the canopy closed and electrical power on, test the canopy seal as follows:

a. Connect a pressure gage and air pressure supply to canopy seal ground pressurization test fitting. Pressurize canopy seal to 24 psi; then, cut off pressure supply.

b. Allow canopy seal to be pressurized for 15 minutes. Maximum leakage should be 2 psi.

4-99. REMOVING AND INSTALLING CANOPY SEAL.

REMOVING

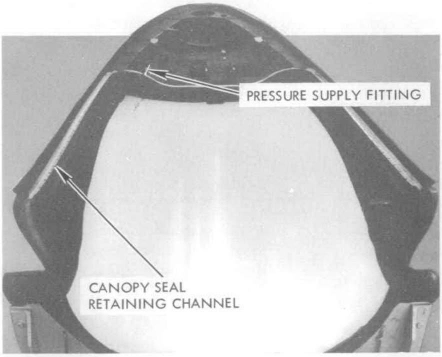
1 Remove canopy from airplane and place in suitable cradle. (Refer to paragraph 2-31.)

2 Disconnect pressure supply fitting from aft side of canopy seal.

3 Pull canopy seal from retaining channel.

4 Clean channel by pulling away residual sealant. Use wire brush to clean away remainder of sealant. If a cleaner is required, use only Turco stripper (item 121, materials list).

Caution Mask off area of canopy glass as Turco stripper will craze the acrylic plastic.



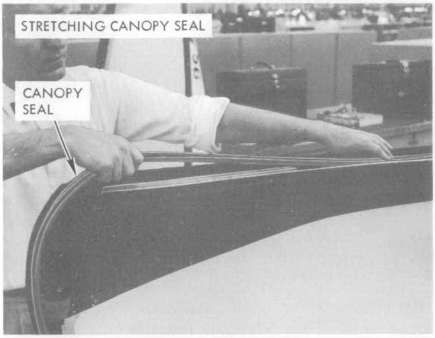
INSTALLING

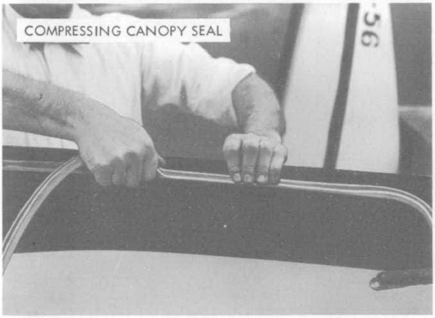
1 Ascertain that all scraps of old seal are removed from channel (step 4 of removing).

2 Press inflatable seal into retaining channel for a trial fit. If seal is too short, stretch the straight portions carefully along sides of canopy. If seal is too long, compress seal while pressing into retaining channel along each side of canopy.

Note The above trial installation is important as canopy seal is difficult to fit after rubber adhesive has been applied to seal and sealing compound has been applied to channel.

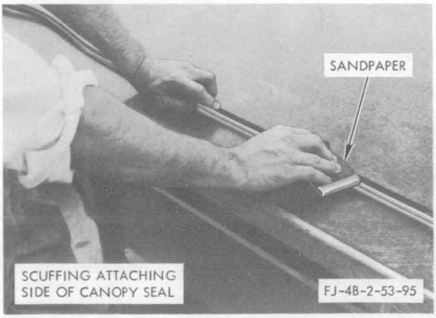
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3 Lightly scuff the attaching side of the inflatable seal with coarse sandpaper and wipe clean with clean cloth dampened with aromatic petroleum naphtha (item 92, materials list).

Warning Aromatic naphtha is flammable. Use with adequate ventilation and avoid prolonged breathing of vapors.



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APPLYING RUBBER ADHESIVE TO CANOPY SEAL

4 Apply light brush coat of rubber adhesive (Vulcabond V-36, American Latex Products, item 4, materials list) to bonding surface of seal and allow to air dry for approximately 30 minutes. This material is used as a tie coat for bonding of the rubber seal to the sealant.

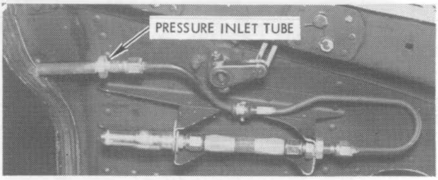


APPLYING SEALING COMPOUND TO RETAINING CHANNEL

5 Apply a bead of accelerated sealing compound (EC-801, Minnesota Mining & Manufacturing Co., item 111, materials list) to the seal retaining channel on the canopy.

Note The base compound and accelerator shall be mixed together in the proportions recommended by the manufacturer. The two components must be blended until there is a uniform dispersion of accelerator through the mixture. A fillet made from sealant that has been improperly mixed will have areas where the cure is incomplete. At room temperature 75°(±5)F, the sealing compound must be used within three hours after being mixed with the accelerator or after removal from cold storage. (After the addition of the accelerator, the sealing compound may be stored at 0° to -10°F for 73 hours.)

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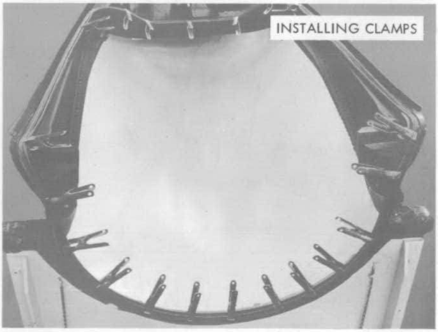
6 Press inflatable rubber seal into retaining channel of canopy. First, position pressure inlet tube portion of seal in slot of retaining channel; then install remainder of seal. Allow seal to remain undisturbed for a minimum of 24 hours at a temperature of 75°(±5°)F.

Note This is very important as every 10° F drop in temperature will double the curing time of the sealant.



PRESSING CANOPY SEAL INTO RETAINING CHANNEL

7 Install "C" clamps or any suitable clamps which are available to retain inflatable seal in the retaining channel until sealant has cured.



INSTALLING CLAMPS

8 Remove "C" clamps after 24 hours and connect pressure supply fitting to aft side of canopy seal.

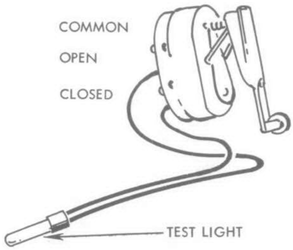
9 Remove excess cured sealing compound by carefully trimming away with a knife.

Caution Care must be exercised to prevent damaging inflatable seal.

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4-100. ADJUSTING CANOPY SEAL DEPRESSURIZING CONTROL MICROSWITCH.

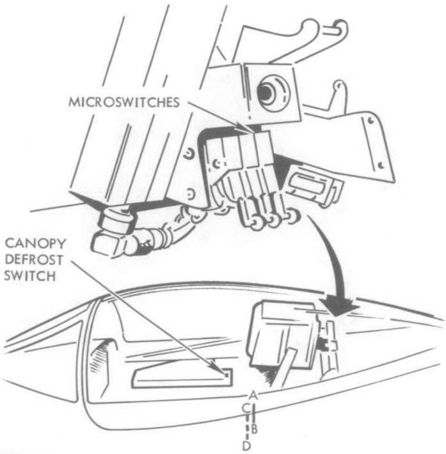
1 Provide a test light and connect one lead to the closed and the other to the open terminal of the microswitch.



2 Provide external power to the airplane and position the CANOPY DEFROST switch to "OFF."

3 Depress the microswitch arm. The test light should illuminate; if not, change the test light lead from the open to the common terminal of the microswitch.

4 Slowly close canopy with the external canopy control switch until test light illuminates.



5 Draw vertical line "AB" across mating line of canopy and fuselage.

6 Draw vertical line "CD" 1/8-inch forward of line "AB" as shown.

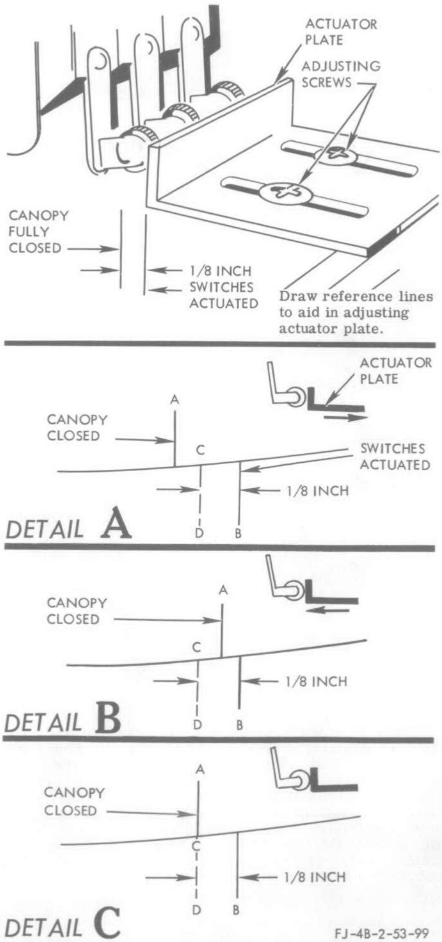
7 Close canopy fully.

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8 Adjust canopy switch actuator plate to provide approximately 1/8-inch override after actuation of all switches. This may be accomplished by moving canopy switch actuator plate aft the distance between line segment A and CD (detail A) or moving the actuator plate forward the distance between line segment A and CD (detail B).

9 Re-check by drawing new reference lines and repeating step No. 8. The correct adjustment is shown in detail C.

10 Repeat step No. 1 through No. 8 for each microswitch.



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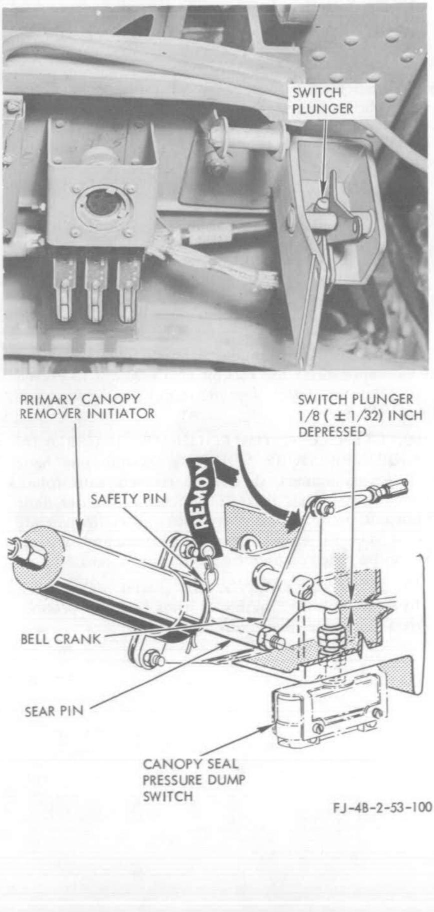
4-101. ADJUSTING CANOPY SEAL DUMP MICRO-SWITCH.

Warning Make sure canopy initiator safety pin is installed before canopy seal emergency seal dump switch is adjusted.

1. Be sure hole in bell crank linkage is aligned with hole in sear pin located on aft right-hand side of headrest.

2. Be sure face curtain handle is all the way in the face curtain assembly.

3. Adjust canopy seal dump microswitch so that the switch plunger is depressed 1/8 (±1/32) inch.



4-102. CANOPY SEAL SHUTOFF VALVE AND PRESSURE REGULATOR.

4-103. The canopy seal shutoff valve and pressure regulator (figures 4-26 and 4-27) is located on the left-hand side of the primary heat exchanger air intake duct. This valve is a combination pressure regulator, relief valve and shutoff valve. The pressure regulator section of the valve controls the pressure by spring tension; when the spring is compressed, a ball-type valve is seated, shutting off the flow of pressure. The relief valve section is composed of a spring-loaded, ball-type valve which vents excess pressure to the outside when the shutoff valve is closed or the pressure is too great. The shutoff valve is controlled by an electric solenoid which, when energized, opens and permits pressure flow to the canopy seal, provided the canopy seal depressurizing control microswitch, canopy seal limit switch (CANOPY) and canopy seal dump microswitch are closed. To adjust the canopy seal pressure regulator, loosen locknut and turn screw clockwise to increase pressure; turn screw counter-clockwise to decrease pressure. Be sure to retighten lock-nut while holding adjustment screw so as not to change adjustment setting. The regulator should be adjusted to 20 psi.

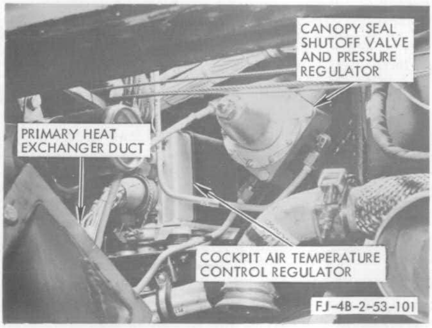


Figure No. 4-27. Canopy Seal Shutoff Valve and Pressure Regulator

4-104. COCKPIT PRESSURE SEALING.

4-105. If the cockpit pressurization system does not perform properly during periodic ground checks, then the pressure-sealing compound applied to the structure must be repaired or replaced. With the cockpit pressurized, isolate the source of leakage on the inside by running a piece of rubber tubing, connected to the free end of a stethoscope, along the seams in the leakage area. (The leakage can be detected by the change in sound when the tube is passed over the leak.) Repairing leakage area under pressure can be accomplished by following the procedure outlined in paragraph 4-108.

WARNING

- With personnel inside, the cockpit *should never* be pressurized to a pressure higher than has been previously established during testing with cockpit empty.
- No one who has recently had a cold, or has had his sinuses impaired in any way, should work in the cockpit under pressure.
- An experienced operator must be present at the pressurization equipment control panel at all times while the cockpit is pressurized.
- While the cockpit is under pressure, all personnel should stay clear of the canopy.
- While the cockpit is being pressurized, the pressure change *should never* exceed a 1000-foot per minute altitude change as indicated on a rate-of-climb indicator. (Refer to paragraph 4-78.)

4-106. CLEANING SURFACES TO BE SEALED. All surfaces to be sealed must first be cleaned to ensure maximum adhesion between the sealing compound and the surface. Clean the area to be sealed as follows:

a. Using a vacuum hose, thoroughly clean surface of all loose dirt.

b. Moisten a clean cloth with solvent (item 119, materials list) and clean area around spot to be sealed. To avoid contamination, pour solvent onto cloth, never dip cloth into solvent container. For effective cleaning, wipe surface dry with a clean cloth before the solvent has had a chance to dry.

c. Repeat step b. as often as necessary to clean thoroughly. Never use a dirty cloth and discard any cloth as soon as it becomes soiled.

4-107. APPLYING SEALING COMPOUNDS. Application of sealing compounds must always be on the pressure side (inside) of the cockpit. A second coat of sealing compound may be applied after the first coat has been allowed to cure completely. If applicator guns are used to apply the sealant, they should be cleaned as soon as possible with cleaning solvents after use (paragraph 4-109); otherwise, any sealant which cures inside the gun must be cleaned out manually.

4-108. REPAIRING LEAKAGE AREAS UNDER PRESSURE. Leaking areas can be repaired from inside the cockpit while it is pressurized (paragraph 4-78). When leaks are located, repair the area by sealing until it is impossible to detect any change in sound when the stethoscope or rubber tubing is passed over the location, or until the person on the outside indicates that the leak has stopped. Use sealing compound [item 111, materials list (EC 1528, Minnesota Mining and Manufacturing Company, or 707, Coast Proseal Manufacturing Company, or PR 1222, Products Research Company)] as follows:

a. Seal holes and gaps up to 1/16 inch in width with a fillet of sealing compound. No backing strip is necessary.

b. Seal holes and gaps from 1/16 to 3/16 inch in width with a backing strip of pressure-sensitive tape (item 124, materials list) applied over the opening on the pressure side and a fillet of sealing compound applied over the tape.

c. Seal holes and gaps larger than 3/16 inch in width by first plugging with balsa wood, metal, caps, plugs, etc, on the pressure side of the area; then, apply the pressure-sensitive tape and sealing compound as in step b. Sealing compound is best applied to the leaking area with a spatula or metal strip.

Note

Do not apply sealing compound by picking it up after wetting the fingers in water, soapy water, engine oil, hydraulic fluid, or protective hand cream as a film of any of these will cause poor adhesion of the mixture to the surface to be sealed.

d. After the repairs under pressure have been completed, depressurize the cockpit at a rate not to exceed a rate of ascent of 1000 feet per minute, using a rate-of-climb indicator.

4-109. CLEANING OF EQUIPMENT USED IN COCKPIT PRESSURE SEALING. Within one hour after use, equipment should be cleaned with toluol (item 133, materials list). If the cleaning is not done within one hour (unless compound and equipment are held at subzero temperatures), the compound will set and can be removed only by mechanical means.

4-110. SPECIAL SEALING. For special sealing such as hydraulic fittings, push-pull rods, electric pressure barriers and cables, see figure 4-28.

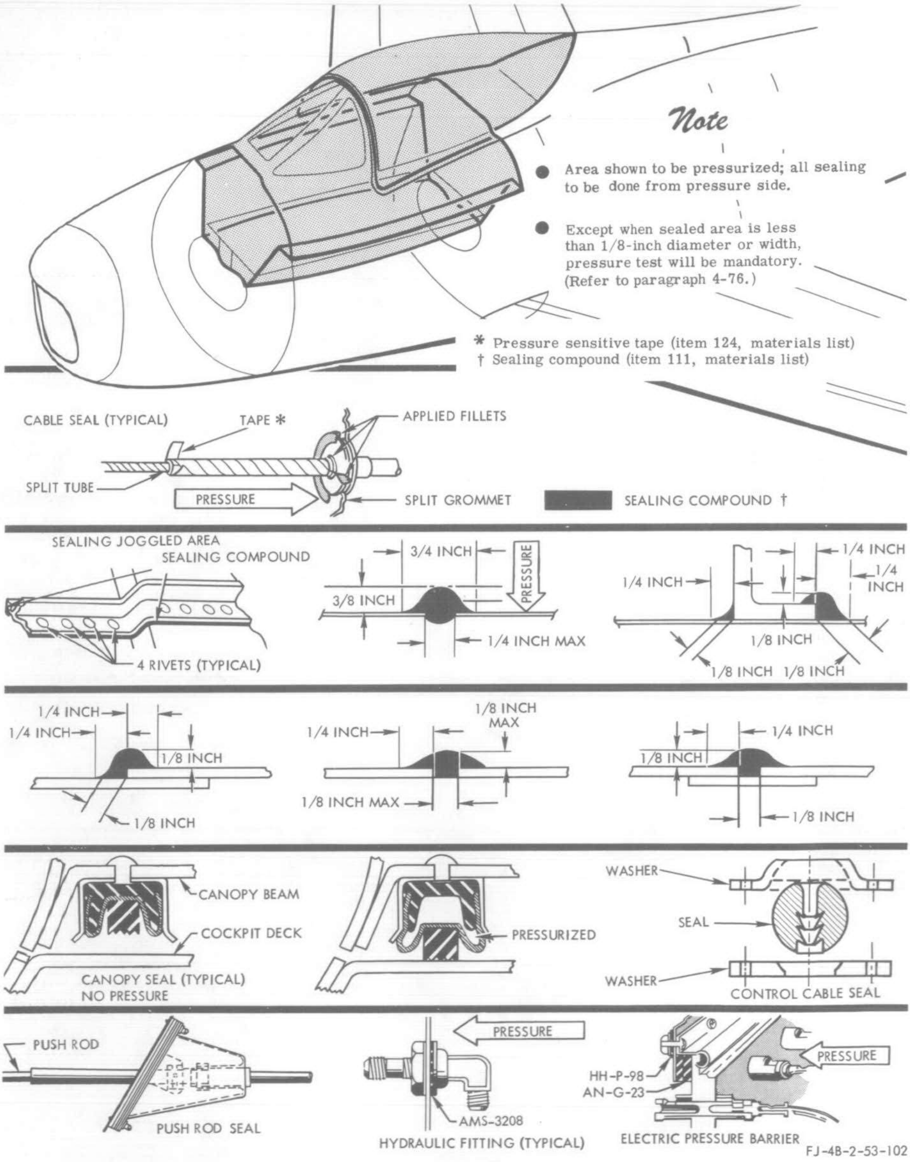


Figure No. 4-28. Cockpit Pressure Sealing

LIQUID OXYGEN SYSTEM

4-111. LIQUID OXYGEN SYSTEM.

4-112. The pilot's breathing oxygen system is a low-pressure system providing gaseous oxygen to the diluter demand regulator at a pressure of 70 psig and with delivery rates up to 20 liters per minute as demanded by the pilot. The normal delivery rate of the system is 10 liters per minute. The oxygen is delivered to the pilot at a temperature no greater than 10°F above cabin temperature and no colder than 20°F below cabin temperature. The gaseous oxygen supply is maintained by means of a liquid oxygen conversion system. This conversion system maintains the delivery pressure and volume by controlled evaporation of the liquid oxygen. The liquid oxygen system (figure 4-29), which supplies pilot's breathing oxygen, consists of a removable spherical container (which has a capacity of 5 liters) incorporating a filler valve and a quantity indicating probe, a relief valve, a pressure control valve, a heat exchanger, an automatic, positive-pressure diluter-demand oxygen regulator and a quantity indicating system. The quantity indicating system provides a probe unit, an amplifier, an indicator and a press-to-test low level oxygen warning light.

Note

For information on the liquid oxygen indicating system, refer to Section VI.

Illuminating provisions are provided for the system pressure gage and flow indicator which are incorporated in the oxygen regulator. A standard pilot's disconnect assembly is provided for the pilot's oxygen mask, and a seat ejection disconnect assembly is provided to retain the flexible oxygen hose. The oxygen system may be serviced by means of a filler valve on the container disconnect panel. The oxygen container can be removed easily for servicing or may be replaced with a fully serviced container. All units of the liquid oxygen conversion system, with the exception of the diluter demand regulator and the contents gage, are located in the oxygen compartment. The system uses liquid oxygen, Grade B, Type II (item 97, materials list). Liquid oxygen is a light blue liquid weighing 2.52 pounds per liter at one atmosphere pressure and having a boiling point of −183°C (−297.4°F). At this temperature and pressure, gaseous oxygen is boiled off at an expansion ratio of 862 to 1. The liquid oxygen system has a capacity of 5 liters and is stored in a container located in the oxygen compartment on the left side of the forward fuselage. This liquid oxygen container (flask) supplies as much gaseous oxygen as five 514 cubic inch gaseous oxygen cylinders with a weight reduction of 73 percent and a space reduction of 92 percent. The liquid oxygen system has a working pressure of 70 psi.

4-113. FUNCTION OF LIQUID OXYGEN SYSTEM.

4-114. The liquid oxygen supply line (at the bottom of the container) provides the supply of liquid oxygen, through tubing and a flexible metal braided hose to the pressure control valve (normally, the oxygen will be in a gaseous state upon reaching the control valve), through the heat exchanger (which will warm the gaseous oxygen to normal breathing temperatures) and to the oxygen regulator. The pressure control valve controls the pressure in the liquid oxygen container through the vent and build-up line. When the container pressure drops below 65 psi, the valve opens until the pressure reached is 70 psi; then, the valve closes. When the system is not in use, a system relief valve is provided to vent excessive pressures overboard. The relief valve will open at pressures between 100 and 120 psi. Normal boil-off of the liquid oxygen will delete approximately one liter from the system during a 24-hour period.

4-115. MAINTAINING LIQUID OXYGEN SYSTEM.

4-116. Leaks in pipe threaded connections should be completely eliminated since the leakage rate may increase with time and vibration. If leaks cannot be eliminated without excessive torquing (figure 4-32), the leaking connection should be disassembled and the fitting replaced. Use only approved combination anti-seize and thread sealing compound (item 130, materials list).

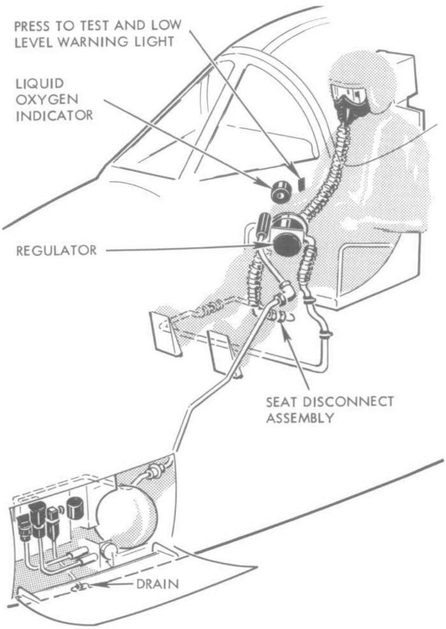
CAUTION

Apply thread sealing compound carefully and sparingly to the first three threads only of fittings with male tapered threads.

Flared tube connections, which are leaking excessively, should be tightened to the maximum torque values (figure 4-32). If the leakage remains excessive, the connection should be disassembled and the fitting replaced.

CAUTION

- Do not use anti-seize and thread sealing compound on flared tube connections. Never apply compound on flare to prevent leakage.
- Keep all oxygen equipment, lines and fittings free from grease, dirt, oil and leaks. Use anti-icing fluid (item 52, materials list) for cleaning the outside of metal parts and lines. Use a mild soap solution (item 115, materials list) for cleaning rubber parts.



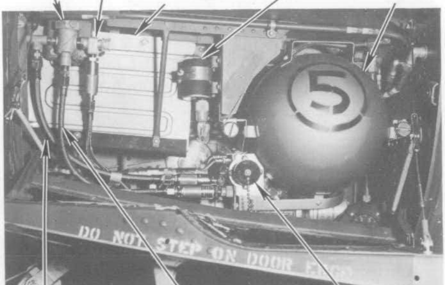


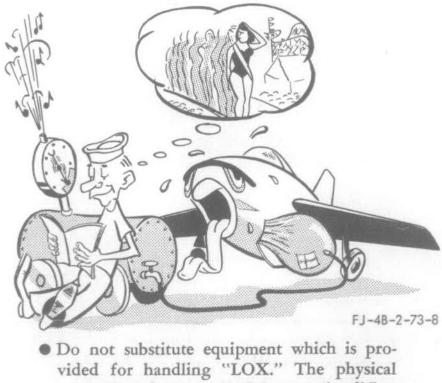
Figure No. 4-29. Liquid Oxygen System

4-117. SAFETY PRECAUTIONS.

4-118. Liquid oxygen (commonly known as "LOX") can be extremely hazardous if improperly handled. The precautionary notes in the following paragraphs should be observed at all times when handling "LOX." "LOX" is dangerous to those not familiar with its characteristics, but handling and maintaining the liquid oxygen system can be routine and safe to those who understand its properties and observe the necessary precautionary measures.

WARNING

- Never store or handle "LOX" in a poorly ventilated area or close to inflammable materials. Organic materials such as clothing, cigarettes and oils, when splashed with "LOX," will burn violently if ignited within several minutes after exposure. Once a liquid oxygen fire is started, it is virtually impossible to extinguish it. Flames, sparks, burners, heaters and exhausts must be kept away from "LOX" storage vessels, portable units and the airplane while fluid is being transferred. Extreme care must be taken not to splash or spill liquid oxygen onto clothing. Mixed with cloth, an ideal and deadly situation for a fire exists—a fire that cannot be put out. Clothing, worn during liquid oxygen servicing, should be of a closely knit material such as poplin. Synthetic fabric which generates static electricity or any loosely knit absorbent wool or cotton clothing should be avoided.



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- Do not substitute equipment which is provided for handling "LOX." The physical properties of many materials are quite different when at −297°F than they are at room temperature. Rubber shatters like glass, some metals get brittle and lose their strength, etc.

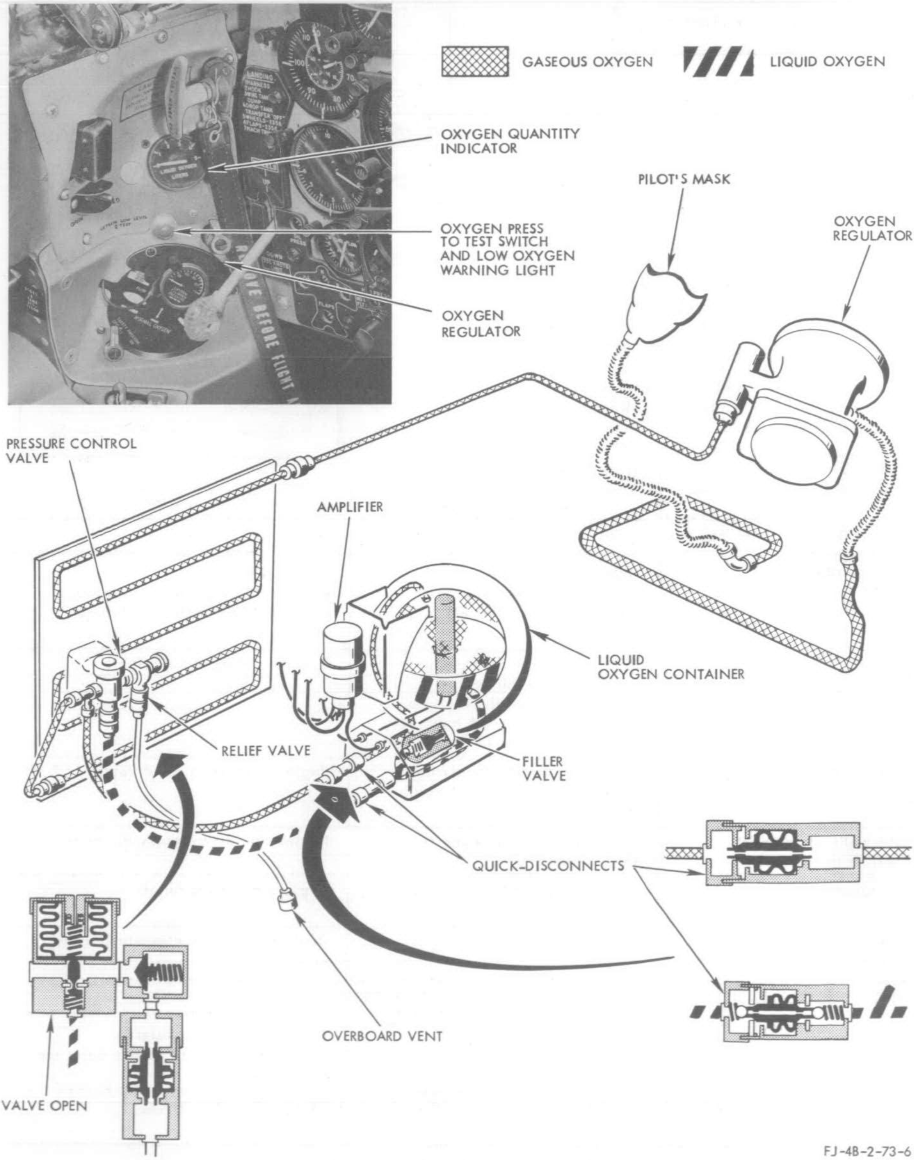


Figure No. 4-30. Liquid Oxygen System—Schematic

WARNING

- The extreme cold of "LqOX" will instantly produce pain if held in contact with the skin. Avoid touching bare metal lines containing "LqOX," as bare skin will instantly freeze to the —297°F metal. Protective equipment consisting of a suitable face shield, apron and gloves must be worn when handling "LqOX."
- When a completely empty system is serviced, the "LqOX" must be added slowly to cool the system equipment down to the —297°F storage temperature. The equipment may be damaged by thermal shock or excess pressure if the "LqOX" is forced in too rapidly.
- Never seal "LqOX" in an unvented container. "LqOX" sealed off at room temperature can develop a pressure of more than 12,000 psi.



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4-119. TROUBLE SHOOTING LIQUID OXYGEN SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
EXCESSIVE OXYGEN LOSS AND/OR LOW OR NO SYSTEM PRESSURE.		
Leaking filler valve.	With the filler valve cap screwed on tight, soap test the filler valve for leaks.	Repair filler valve. Replace "O" ring. (Refer to paragraph 4-127.) Replace defective filler valve.
Loss of vacuum in container.	Check container exterior for frost or coldness, or fill container with "LqOX" and weigh the container and contents after 24 hours (40 ounces maximum allowable loss).	Replace defective container.
Leaking relief valve.	Disconnect line assembly from relief valve and soap test outlet for leaks.	Replace defective relief valve.
Quick-disconnects on flexible line leaking.	Soap test quick-disconnects for leakage.	Replace defective quick-disconnects.
Ruptured line(s).	Visually inspect the system and perform soap test.	Replace defective line(s).
Defective pressure control valve.	Bench check.	Replace defective pressure control valve.
EXCESSIVE OXYGEN LOSS AT FILLER VALVE DURING SERVICING.		
Defective "O" ring in filler valve.	Visual leakage.	Replace "O" ring. (Refer to paragraph 4-127.) Replace defective filler valve.
INCORRECT INDICATIONS FROM LIQUID OXYGEN INDICATING SYSTEM OR LOW LEVEL WARNING LIGHT.		
	Refer to paragraphs 6-401 and 6-402.	

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
NO PRESSURE READING ON REGULATOR GAGE.		
Pressure gage defective. (Refer to trouble EXCESSIVE OXYGEN LOSS AND/OR LOW OR NO SYSTEM PRESSURE.)	Turn on OXYGEN SUPPLY and SAFETY PRESSURE valve knobs and with air dilution valve knob in "100% OXYGEN," hold hand near end of flexible hose. Flow of oxygen should be felt.	Replace defective regulator.
LEAK AROUND OXYGEN FITTINGS.		
Broken flares on tubing.	Visually inspect connections in system.	Replace defective line or connection.
Damaged fittings.	Visually inspect fittings in system.	Replace damaged fittings.
REGULATOR FAILS TO DELIVER OXYGEN.		
Defective regulator. (Refer to trouble EXCESSIVE OXYGEN LOSS AND/OR LOW OR NO SYSTEM PRESSURE.)	Connect mask to flexible hose connection, turn on supply and safety pressure valves and attempt to breathe through mask. If mask collapses, regulator is defective. If disconnects are installed properly and not leaking, pressure control valve is operative and no lines are broken or crimped.	Replace defective regulator.

4-120. LEAKAGE TEST OF LIQUID OXYGEN SYSTEM.

WARNING

Liquid or gaseous oxygen can be extremely hazardous if it comes in contact with oil, grease, hydraulic fluid, dirt or an open flame. Extreme caution should be taken not to touch any uninsulated metal lines, containers or other implements holding liquid oxygen unless special gloves are worn. Primarily, protect the eyes and skin when exposed to liquid oxygen.

a. Be sure airplane is away from hangar and all other enclosures.

b. Drain the oxygen system or replace the container with a perfectly empty container that has been purged with gaseous oxygen. (Refer to paragraph 1-37 for draining and paragraph 4-123 for purging.)

c. Fabricate an oxygen test gage assembly (figure 4-31).

d. Position OXYGEN SUPPLY valve knob to "OFF."

e. Connect test gage assembly to filler valve and service the system with gaseous oxygen to a pressure of 70 psi. Disconnect supply source from test filler valve.

f. After one hour, record the pressure reading on the test gage and record the time.

g. The oxygen pressure reading on the test gage should be recorded again after ½ hour. The maximum allowable pressure drop during this 30-minute period is 10 psi.

h. If oxygen pressure drop is more than 10 psi in the 30-minute period, apply soap solution (item 115, materials list) externally to all lines, fittings and disconnects to locate leakage.

CAUTION

In testing filler valve for leakage, extreme care should be exercised in applying soap film to the face of the valve so that no soap solution runs into the valve.

The lines, fittings and disconnects tested should be wiped clean and dry immediately after testing.

i. If leakage persists, refer to paragraph 4-115 for maintaining liquid oxygen system.

4-121. ODOR TEST OF LIQUID OXYGEN SYSTEM. To eliminate the possibility of serving airplanes with contaminated liquid oxygen, an odor test should be accomplished on all liquid oxygen storage facilities and "LqOX" servicing trailers. The procedure for performing this test is as follows:

a. Connect a section of clean plastic hose to the supply line of the servicing trailer or aircraft system. (This will aid in collecting samples.)

b. Cover the bottom of a clean 400-cc (approximately one pint) beaker with clean, dry filter paper. Provide a watch glass cover to partially cover the top of the

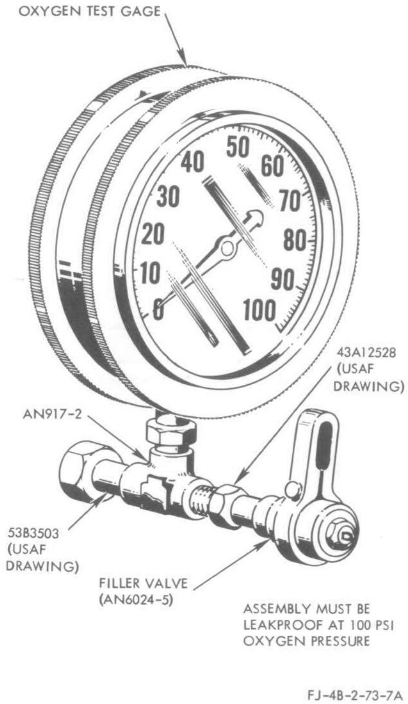


Figure No. 4-31. Fabrication of Liquid Oxygen System Test Gage

beaker. (This cover is provided to prevent odors from the surrounding atmosphere being absorbed into the liquid oxygen sample.)

c. Collect approximately 200 cc (1/2 pint) of liquid oxygen from the vent line (or overflow outlet) in the 400-cc glass beaker. (The container should be covered while collecting the sample and during the remainder of the test.)

d. Allow sample of liquid oxygen to evaporate to dryness in an area free of air currents or odors.

e. Immediately after the liquid oxygen has evaporated, raise cover of beaker and smell the vapors.

f. Repeat the smelling of the vapors in the beaker at frequent intervals until the accumulated frost on the outside of the beaker has completely melted.

CAUTION

Liquid oxygen which is suspected of being contaminated must be disposed of in accordance with local directives.

4-122. EVAPORATION LOSS TEST OF LIQUID OXYGEN SYSTEM. The following test must be conducted after servicing the system with liquid oxygen (paragraph 1-37) and at any time maintenance has been performed on the system, such as removal of lines, fittings, disconnects, valves, etc.

a. One hour after fully servicing the system with liquid oxygen, use a wax pencil to mark the position of the needle on the glass face of the liquid oxygen quantity gage.

b. Twenty-four hours after marking the liquid oxygen quantity gage, read the gage again.

c. The maximum acceptable loss of liquid oxygen during the 24-hour period is one liter. If the loss of liquid oxygen exceeds one liter during the 24-hour period, test the system for leakage (paragraph 4-120) and/or trouble shoot for excessive oxygen loss and/or no system pressure (paragraph 4-119).

4-123. PURGING LIQUID OXYGEN SYSTEM. The system can be purged by the following steps:

WARNING

It is mandatory to purge the liquid oxygen system if the system has been empty for several hours or if the system has been left open due to replacement of parts without all lines and components being capped or plugged.

a. Drain the liquid oxygen container (paragraph 1-37) and connect the fabricated oxygen test gage assembly (figure 4-31) to the container filler valve.

b. Connect a gaseous oxygen service trailer supply line to the filler valve on the oxygen test gage assembly.

Note

If available, hot, dry, water-pumped nitrogen (approximately 150°F) may be used to purge the airplane system in place of gaseous oxygen. (Refer to BuAer Aviation Clothing and Survival Equipment Bulletin No. 7-57, dated 1 March 1957.)

c. Position regulator supply valve to "ON," regulator air dilution valve at "100% OXYGEN" and regulator SAFETY PRESSURE valve to "ON."

d. Turn on oxygen supply valve on gaseous oxygen service trailer and set the oxygen service trailer regulator to 50 psi.

e. Purge the system at 50 psi gaseous oxygen pressure for a period of 30 minutes.

Note

When purging the system with nitrogen, two hours are required to completely purge the system.

f. Shut off oxygen supply and disconnect line from filler valve.

g. Remove oxygen test gage assembly and install cap on container filler valve.

h. Position regulator supply valve to "OFF," regulator SAFETY PRESSURE valve to "OFF" and regulator air dilution valve to "NORMAL OXYGEN."

WARNING

After using nitrogen to purge the liquid oxygen system, the system must be repurged with gaseous oxygen for a period of one minute. This prevents the possibility of the pilot's breathing nitrogen since an undetermined amount of nitrogen may be trapped in the system's lines after filling the container with liquid oxygen.

i. Service system with liquid oxygen. (Refer to paragraph 1-37.)

4-124. LIQUID OXYGEN SYSTEM CONTAINER.

4-125. The liquid oxygen container is located in the oxygen system compartment, forward and below the cockpit windshield on the left-hand side of the airplane. The container (or flask) is a portable, double-walled, vacuum insulated vessel, primarily used to store liquid

TABLE 1 TORQUE VALUES FOR FLARE TYPE COUPLING NUTS		
TUBE OD INCH	TORQUE INCH-POUNDS	
	WORKING TORQUE	MAXIMUM TORQUE
5/16	100	125
3/8	200	250
1/2	300	400

TABLE 2 MAXIMUM TORQUE FOR PIPE THREADED FITTINGS	
PIPE THREAD	MAXIMUM TORQUE INCH-POUNDS
1/8	175
1/4	300
3/8	450

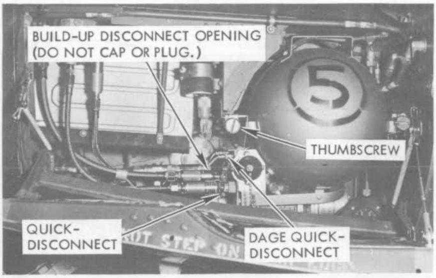
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Figure No. 4-32. Torque Value Chart for Oxygen System Fittings

oxygen in the airplane prior to the liquid-to-gas conversion. The container has a volume of 5 liters (5.3 quarts) of liquid oxygen. Incorporated in the container is a capacitance tank unit (probe) to measure the amount of liquid oxygen in the container. A disconnect panel is provided on the forward side of the container which contains the connector for the tank unit (probe) leads and the quick-disconnect connectors for the vent and build-up and supply lines. A filler valve is provided on the lower front side of the container, a handle near the top and a screw fastener on each side to mount the container securely in place. The container has an operating pressure of 70 psi and can withstand a proof pressure of 110 psi without leakage or permanent distortion. The container is satisfactory for service throughout an ambient temperature range of −65°F to +160°F. The internal temperature range of the container is −300°F to +160°F. A ½-inch diameter rupture disk is designed in the bottom of the outer shell of the container to provide a minimum of danger to personnel in case of rupture.

4-126. REMOVING AND INSTALLING LIQUID OXYGEN CONTAINER.

Warning **Be sure to wear asbestos gloves and safety goggles when handling liquid oxygen lines and components as serious harm to skin and eyes can result.**





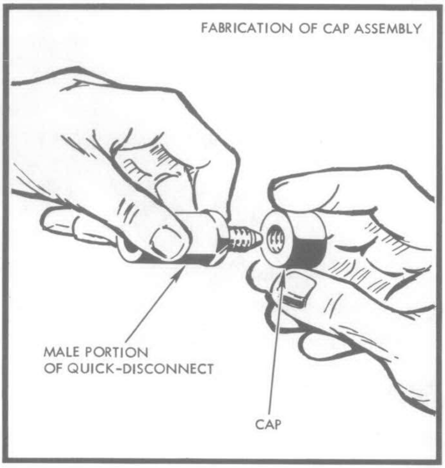
REMOVING

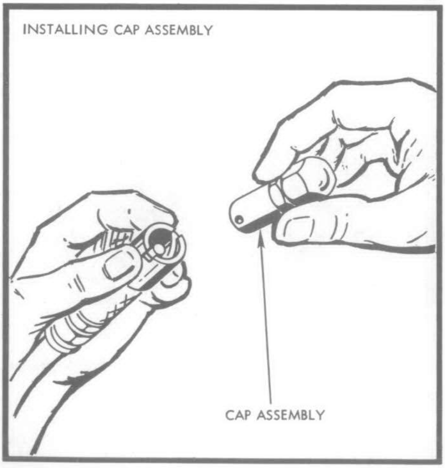
1 Disconnect supply and build-up lines at the quick-disconnects.

Warning **Be sure to install male half of quick-disconnect with intake port capped on each disconnect fitting on supply and build-up flexible lines. This will prevent entry of foreign matter into the oxygen system when container is removed. Be sure these capped disconnect halves are kept clean.**

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Warning Do not cap or obstruct build-up disconnect opening on container. A serious explosion could result.

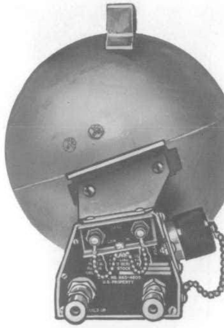




2 Disconnect the two capacitance gaging system leads at the Dage quick-disconnects.

3 Loosen thumbscrews holding container in place and remove container.

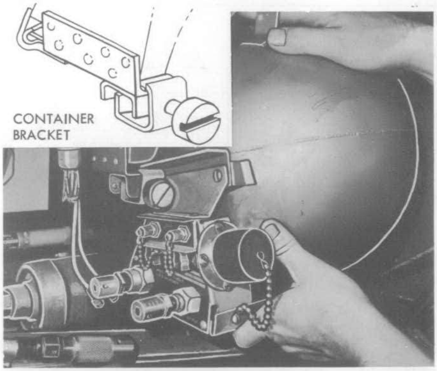
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INSTALLING

1 Position container in place and tighten thumbscrews. Safety with AN995F47 lockwire.

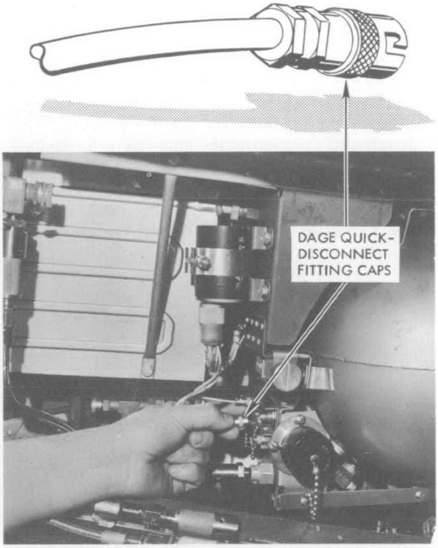
2 Remove male half of capped quick-disconnects from supply and build-up flexible lines.





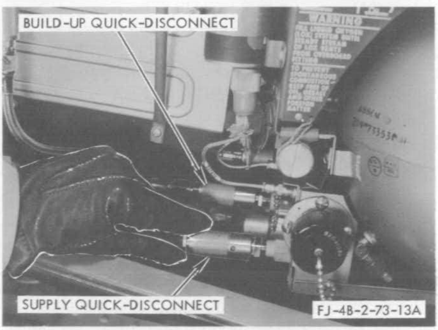
Caution Be sure Dage quick-disconnect fittings and supply and build-up quick-disconnect fittings are clean and free of all foreign matter such as dirt, grease, oil and water.

3 Remove Dage quick-disconnect fitting caps and connect quick-disconnects. Stow caps in clips on container panel.



4 Connect supply and build-up quick-disconnect fittings.

5 Check quick-disconnects and filler valve for visual leakage.



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4-127. INSTALLING TEFLON "O" RING IN LIQUID OXYGEN CONTAINER FILLER VALVE.

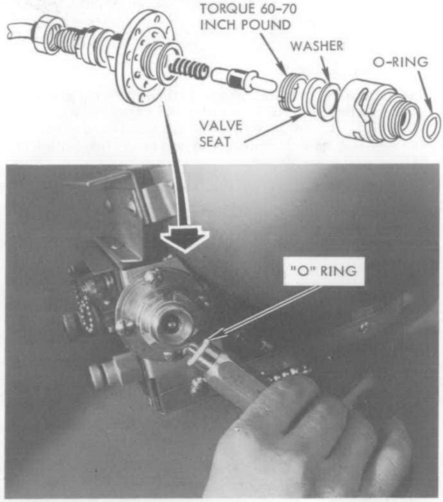
INSTALLING

During servicing of the liquid oxygen system, when the filler nozzle is removed from the filler valve it may be noted that the Teflon "O" ring has been damaged or pulled from its seat. Use the procedure described to replace the Teflon "O" ring when necessary.

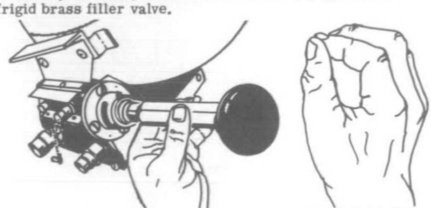
Warning Container should be empty of liquid oxygen prior to installing "O" rings or injury to personnel could result.

1 Position the new Teflon "O" ring on the tool as shown.

Note Be sure all particles of old "O" ring are removed from "O" ring groove.

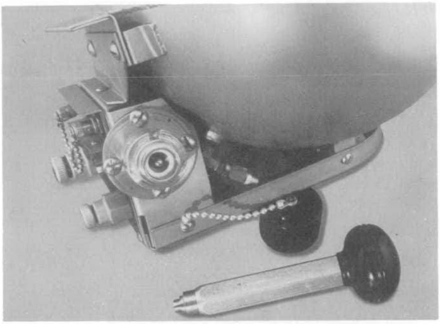


2 Insert the tool as shown; then with the other hand, strike the handle hard to force the ring into the filler neck. This is necessary since the "O" ring fits very tightly in the filler valve neck. The loud crack that will undoubtedly be heard is no cause for alarm. This is caused by the sharp contact of the steel tool against the frigid brass filler valve.

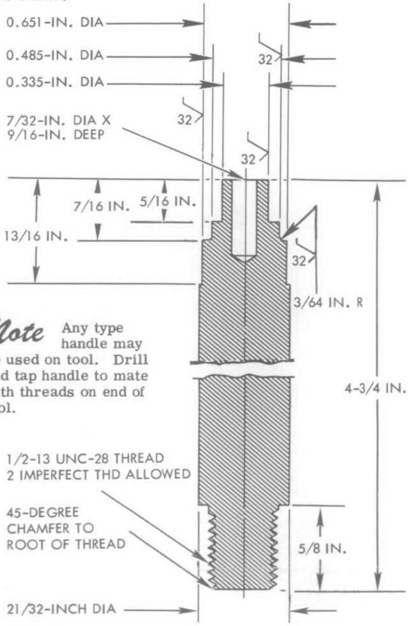


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3 After installing, visually check to make sure that the "O" ring is seated flush in the filler valve neck.



The tool used for installing the Teflon "O" ring may be procured from the ARO EQUIPMENT CORP under P/N OT-301-1. If tool is not available, local manufacture of the tool may be accomplished by use of the fabrication details shown.



Note Any type handle may be used on tool. Drill and tap handle to mate with threads on end of tool.

302 STAINLESS
STEEL PER SPECIFICATION MIL-S-853

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4-128. LIQUID OXYGEN SYSTEM PRESSURE CONTROL VALVE.

4-129. The pressure operated control valve, located forward of the liquid oxygen container in the oxygen compartment, controls the flow of liquid oxygen from the container to the oxygen system and also limits the system pressure to 70 psi. When the system pressure increases above 70 psi, the control valve closes, preventing flow of liquid oxygen from the container into the system. With a decrease of system pressure below 65 psi, the control valve opens, permitting liquid oxygen to flow into the system. The oxygen will be in a gaseous state upon reaching the control valve. The liquid oxygen evaporates, thus increasing the system pressure to 70 psi. This valve also pressurizes the liquid oxygen container, thus aiding the flow of liquid oxygen from the container when the valve is open. The valve operation is controlled by a bellows which is spring-loaded to the closed position and contains two outlet ports and one inlet port.

4-130. LIQUID OXYGEN SYSTEM RELIEF VALVE.

4-131. The system relief valve, located forward of the oxygen container in the oxygen compartment, protects the system in event the pressure becomes excessive. The valve has a cracking pressure of 100 psi and a full flow pressure of 120 psi. The valve is spring-loaded to the closed position with a minimum flow of 100 liters per minute at 120 psig maximum.

4-132. LIQUID OXYGEN SYSTEM HEAT EXCHANGER.

4-133. The system heat exchanger, located forward of the liquid oxygen container and to the rear of the pressure operated control valve, raises the temperature of the evaporated liquid oxygen to ensure that the pilot will suffer no ill effects due to the consumption of oxygen at extremely low temperatures. The heat exchanger is made of aluminum alloy sheet with a serpentine passage running through the center.

4-134. OXYGEN REGULATOR.

4-135. The oxygen regulator is of the automatic, positive-pressure, diluter-demand type for pressure breathing. Only a pressure-breathing type mask can be used with this type of regulator. The regulator incorporates an oxygen flow blinker, a safety pressure control valve, an oxygen supply control valve, an air dilution valve and a pressure gage calibrated in psi. The 150 psi mark on the pressure gage is labeled "FULL." The safety pressure control valve is used for emergency regulator operation and/or mask seal test. The regulator is designed for use in high altitude flight and automatically mixes varying quantities of air and oxygen, the ratio depending on the altitude, and delivers the quantity demanded upon inhalation. The regulator is mounted on a panel on the left side of the cockpit slightly forward of the pilot's seat.

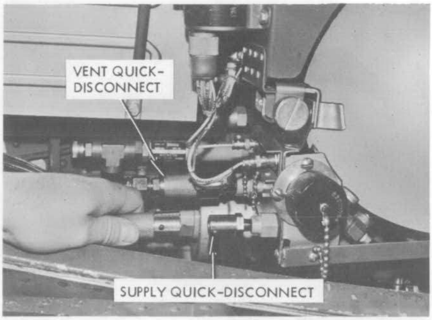
4-136. CHECKING OXYGEN REGULATOR FOR OPERATION. After installation, check oxygen regulator as follows: Turn OXYGEN SUPPLY valve counterclockwise and turn the SAFETY PRESSURE knob clockwise to their "ON" positions; feel to be sure there is oxygen flow at unattached end of breathing tube. If no flow is noted, regulator is defective and should be replaced. Return SAFETY PRESSURE knob to "OFF" position. Oxygen flow may continue because of a suction under the diaphragm caused by a stream of oxygen from the injector. Unless the demand valve is leaking, oxygen flow will stop if the hand is placed over the end of the breathing tube to break this stream. When demand valve leakage is indicated, regulator should be replaced. Set air valve to "100% OXYGEN" and inhale deeply through breathing tube and regulator. If excessive resistance to inhalation is noted, replace regulator. If oxygen flow is obtained during test, but flow indicator does not blink, replace regulator.

4-137. TESTING OXYGEN REGULATOR FOR LEAKAGE. Turn off the oxygen supply pressure and the empty distribution line by turning the SAFETY PRESSURE knob to "ON" position. Set air valve to "NORMAL OXYGEN"; grasp breathing tube and fully stretch breathing tube section between hands. While tube is extended, place thumb over open end of breathing tube and permit breathing tube to contract. Observe blinker (back pressure will operate it). If after 5 seconds, blinker has not returned to its normal position, all portions of the system from the regulator valve to the breathing tube disconnect are acceptable. If blinker returns to normal in less than 5 seconds, examine the system for leaks. Remedy any leaks found and test again. If leak persists, replace regulator.

4-138. REMOVING AND INSTALLING OXYGEN REGULATOR.

REMOVING

1 Bleed pressure from system by uncoupling both the supply and vent quick-disconnect couplings from the LqOX container.

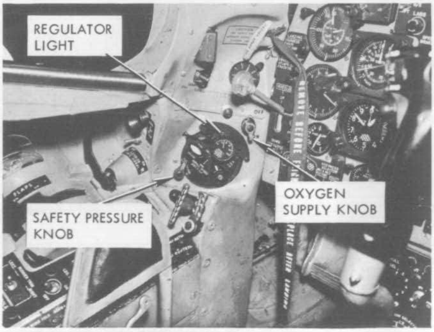


2 Remove the OXYGEN SUPPLY and the SAFETY PRESSURE knobs from the front of the regulator.

3 Remove screws attaching both upper and lower close-out panels.

Warning Do not remove safety pin from canopy emergency release handle.

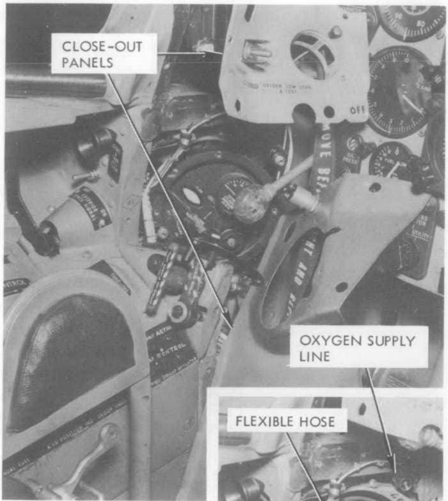
4 Remove screws holding regulator and regulator light to close-out panel.



5 Remove LqOX quantity indicator light hood; then remove indicator by turning fillister head screw counterclockwise. Disconnect electrical quick-disconnect at rear of indicator.

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6 Position close-out panels to facilitate removing regulator.





7 Remove oxygen supply line (flexible metal).

8 Loosen nut on Marman type clamp which retains the regulator.

9 Pull regulator out and disconnect flexible hose.

Caution

- The oxygen regulator is a delicate instrument and must be handled with extreme care.
- All ports should be plugged or taped to prevent entry of foreign matter into the regulator or oxygen system.

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INSTALLING

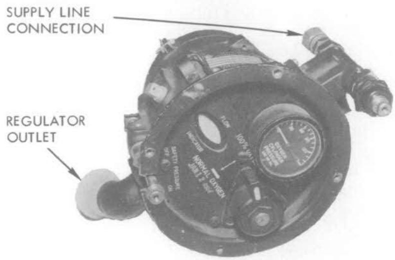
Note Check the regulator to see if the pressure inlet fitting is installed. If not, remove the plug and install the fitting taken from the replaced regulator. Make sure all threads are clean and in good condition.

1 Check to see that the area and lines are free of all foreign matter.

2 Connect flexible hose to regulator outlet.

3 Position regulator in place and maneuver into support clamp. (Do not tighten support clamp.)

4 Connect supply line at top rear of regulator.



Caution Check the clearance between end of SAFETY PRESSURE valve rod end and support clamp by operating the SAFETY PRESSURE valve knob. Reposition regulator if interference is encountered in cycling valve knob.

5 Reconnect quick disconnect couplings to the LIQUID OXYGEN container. After allowing pressure to build up, check regulator operation and test for leakage.

6 Remove the OXYGEN SUPPLY and SAFETY PRESSURE knobs from the front of the regulator and install the close-out panels being sure to position regulator light through cutout in panel.

7 Install screws in close-out panels, regulator light bracket and regulator.

8 Tighten support clamp around regulator.

9 Install OXYGEN SUPPLY and SAFETY PRESSURE knobs, (align knobs to show correct position), oxygen quantity indicator and light hood.

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4-138A. INSTALLING OXYGEN BREATHING TUBE.

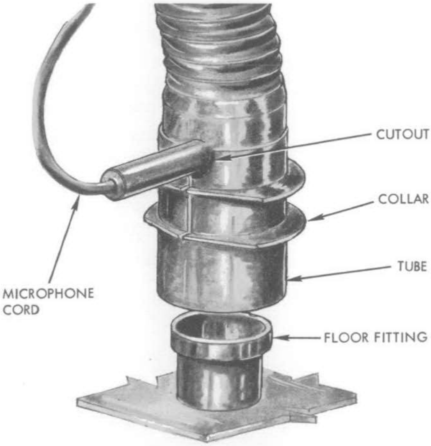
INSTALLING OXYGEN BREATHING TUBE

1 Remove the canopy (paragraph 2-31).

2 Disconnect the canopy initiator linkage from the seat, open oxygen tube bumper and raise the seat six to twelve inches (paragraph 2-63).

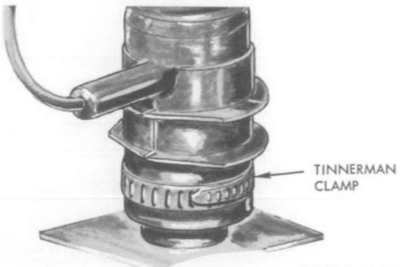
3 Remove the Adel clamp from the oxygen tube collar and the Tinnerman clamp from the oxygen tube.

4 Position the collar on the oxygen tube with the microphone cord in the collar cutout (This will allow access for tightening the Tinnerman clamp).



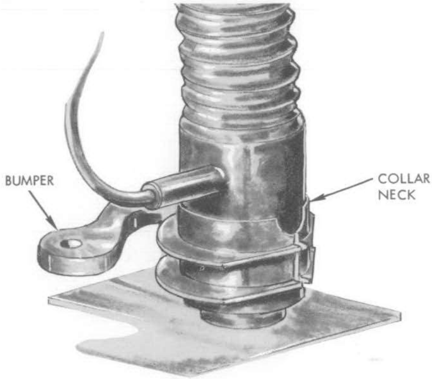
5 Install the oxygen tube over the floor fitting with the microphone cord positioned to the port side of the cockpit and secure firmly with a Tinnerman clamp.

Note Use no substitutes in place of the Tinnerman clamp. Other type clamps can be clamped so tightly that hose separation from the floor fitting during seat ejection would be improbable.



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6 Slide the collar down the tube and over the Tinnerman clamp. Rotate the collar so that the split, flat portion of the collar faces the seat.

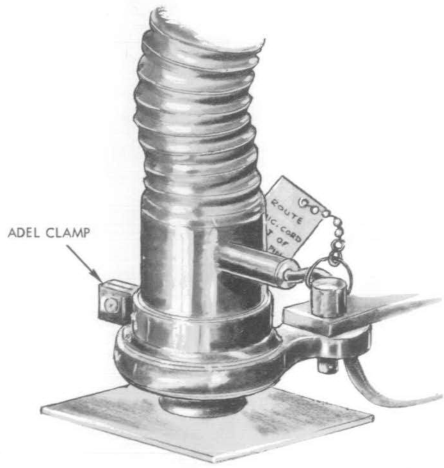


7 Install the Adel clamp on the neck of the collar and tighten.

8 Lower and lock the seat in proper position (paragraph 2-64).

9 Position seat bumper between shoulders of the collar and secure with lockpin provided on front of seat. If necessary, tilt the collar slightly to align with seat bumper.

10 Reconnect the canopy initiator and install the canopy (paragraph 2-33).



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ANTI-G SUIT SYSTEM

4-139. ANTI-G SUIT SYSTEM.

4-140. The purpose of the anti-G suit system is to supply air pressure to inflate the pilot's anti-G suit as required by the amount of acceleration present during violent maneuvers. The system consists of the following equipment (figure 4-33): a supply line, an air filter, a pressure regulating valve, a connecting hose and a suit attachment fitting (quick-disconnect). The air pressure supply line is connected to a duct just downstream of the primary heat exchanger. Air pressure in this duct originates from the engine compressor section.

4-141. ANTI-G SUIT SYSTEM PRESSURE REGULATING VALVE.

4-142. The pressure regulating valve, located to the left of the pilot's seat, regulates the pressurized air received from the primary heat exchanger to provide the proper pressure for operation of the anti-G suit. The valve begins to function at a predetermined number of G's. Pressure delivered depends upon the setting of the valve cap which is marked "HI" and "LO." When the valve cap is set at "LO," the valve opens at approximately 1.75 G and, subsequently, allows one psi of air pressure to pass to the suit for each increment of one G. For example, at 3 G the valve delivers 1.25 psi of air pressure to the suit. When the valve cap is set at "HI," the valve opens at approximately 1.75 G, but delivers 1.5 psi of air pressure to the suit for each increment of one G. For example, at 3 G the valve allows 1.87 psi of air pressure to pass to the suit. When accelerations decrease below 1.75 G, the valve closes and exhausts the suit pressure into the cabin atmosphere, allowing the suit to deflate. The valve assembly contains a relief valve that acts as a safety device by limiting air pressure to the suit in case of valve failure, a manual cap to facilitate inspection of valve operation and two connection fittings. One of the connection fittings, marked "IN," receives the inlet air pressure from the engine compressor section; the other fitting marked "OUT," on the limit valve side, delivers outlet pressure to the anti-G suit. There are three additional screened openings in the valve that do not serve as connection points. They are the discharge outlet, the suit vent and the relief valve opening. It is necessary that the air from these openings be discharged into the cockpit atmosphere in order to maintain proper differential pressures in the suit. A manual test button is located in the selector cap recess for testing the valve operation. The valve requires no maintenance and no repairs can be made. A defective valve assembly should be replaced with a new unit.

4-143. TROUBLE SHOOTING ANTI-G SUIT SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
DURING OPERATIONAL CHECK OF ANTI-G SUIT SYSTEM, AIR DOES NOT PASS OUT THROUGH QUICK-DISCONNECT FITTING.		
Pressure regulating valve not operating properly.		Replace valve.
Inlet line disconnected or broken between valve and suit connection.	Remove line and check for obstruction by passing air through line; check line for leaks.	Replace defective lines.
Air pressure not flowing to pressure regulator valve assembly.	Check line from valve to heat and vent system.	Secure loose connections.
INSUFFICIENT AIR SUPPLY TO ANTI-G SUIT.		
Quick-disconnect fitting not properly seated.	Check for worn or broken fitting or worn "O" ring.	Replace fitting or "O" ring.
Deteriorated flexible hose from quick-disconnect fitting to valve or suit fitting.	Visually inspect hose.	Remove and replace hose.
Weight stuck in pressure regulating valve.	Remove regulating valve by taking off inlet and outlet connections and removing three bolts. Test regulating valve (paragraph 4-146).	If defective, replace regulating valve and check operation of new valve.
EXCESSIVE PRESSURE ADMITTED TO ANTI-G SUIT.		
Relief valve inoperative.	Too much pressure to anti-G suit.	Replace regulator valve.

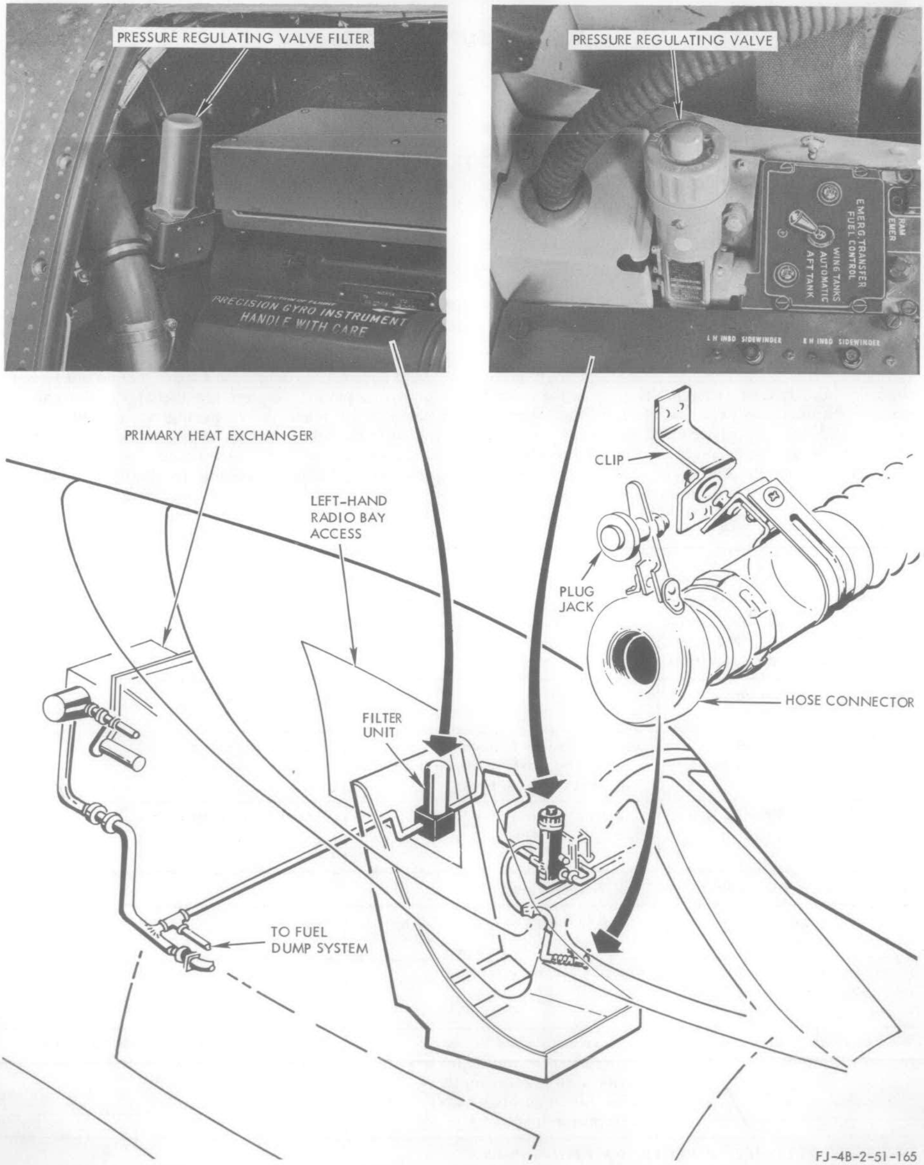


Figure No. 4-33. Anti-G Suit System

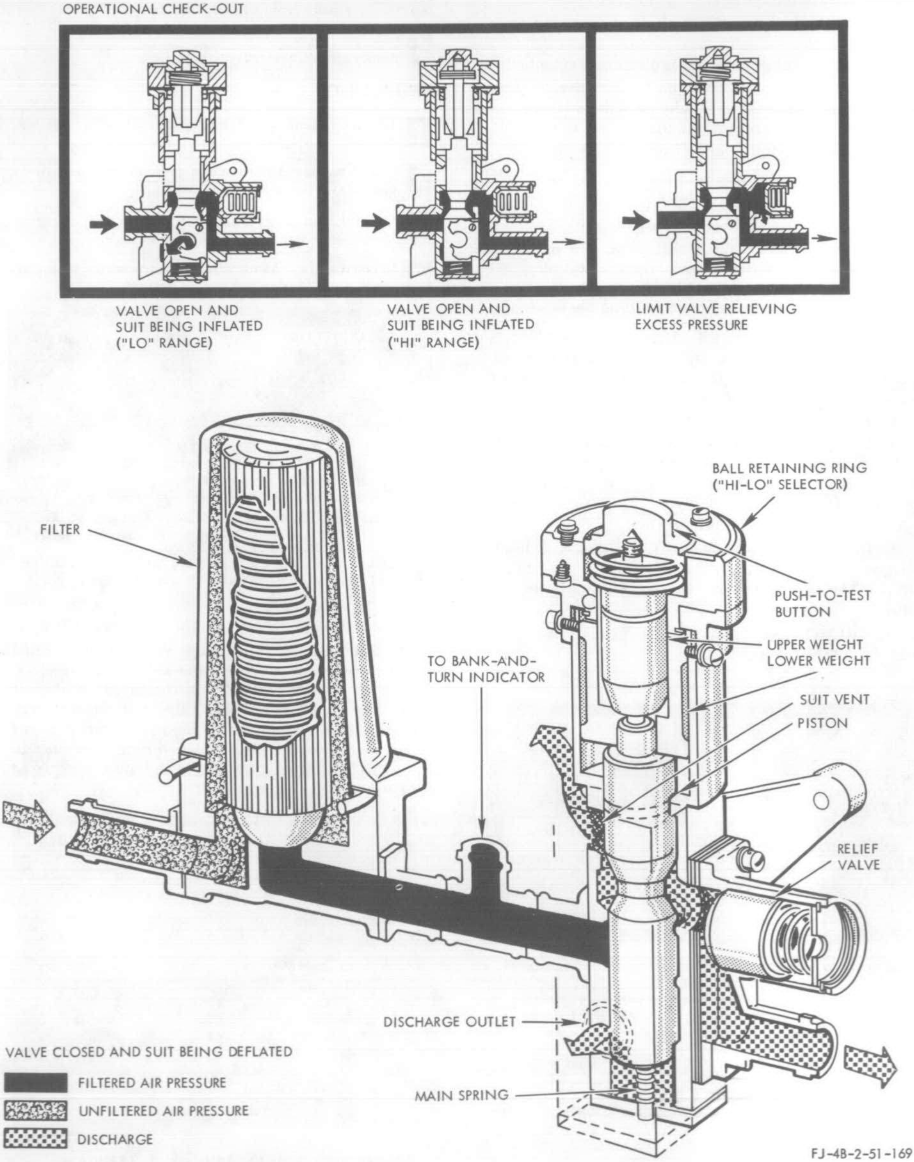


Figure No. 4-34. Anti-G Suit Regulating Valve—Schematic

4-144. CHECKING ANTI-G SUIT SYSTEM.

4-145. To check the system with engine running, proceed as follows:

a. Open jack plug from quick-disconnect assembly.

b. Press manual test button on top of valve. Airflow through quick-disconnect should be substantial and in proportion to the pressure on the manual test button.

c. Release test button and airflow should stop.

CAUTION

When the anti-G suit is not in use, it is most important that the hose connector jack plug be plugged into the hose connector body to prevent foreign matter from reaching the valve.

4-146. TESTING PRESSURE REGULATING VALVE. Before pressure regulating valve is installed, perform the following test to ensure its satisfactory performance in the airplane:

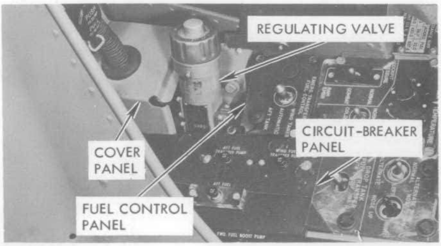
a. Turn valve cap to "LO" setting.

b. Give valve a sudden severe, downward shake while holding it in a vertical position. The piston and the lower weight should drop and return to their original positions (this movement can easily be felt and heard).

c. Turn valve cap to "HI" setting.

d. Repeat downward shake. The piston, the lower weight, the upper weight and the manual cap should drop. (The manual cap can be seen moving down and up.)

4-147. REMOVING AND INSTALLING PRESSURE REGULATING VALVE.



REMOVING

1. Remove aft left circuit-breaker panel, emergency transfer fuel control panel and cover panel aft of regulating valve.

2. Remove clamps and slide back hose at inlet (aft) connection to regulating valve.

3. Remove clamps and slide back hose at outlet (forward) connection of regulating valve.

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4. Remove bolts from support assembly.

5. Remove valve assembly.

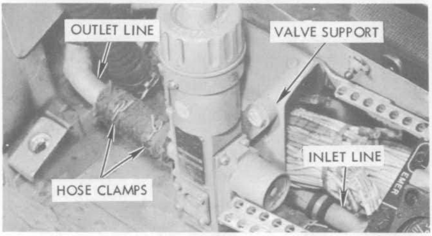
INSTALLING

1. Be sure to test valve for proper functioning. (Refer to paragraph 4-146.)

2. Install valve and bracket assembly to valve support assembly with retaining bolts.

3. Connect inlet (supply) line to inlet port (aft) of regulating valve with hose and install clamps.

4. Connect outlet line to outlet port (forward) of regulating valve with hose and install clamps.



5. Install cover panel aft of valve, emergency transfer fuel control panel and aft left circuit-breaker panel.

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4-148. PRESSURE REGULATING VALVE FILTER.

4-149. The pressure regulating valve filter, located slightly forward on the left-hand side of the receiver-transmitter, RT-178/ARC-27, is connected in the air supply line to the anti-G suit valve and the turn-and-bank indicator. A micronic line-type filter prevents foreign matter from being blown through the duct to these units. The filter is removable and must be replaced when it becomes clogged or dirty.

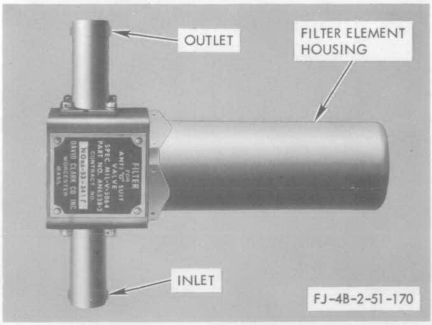
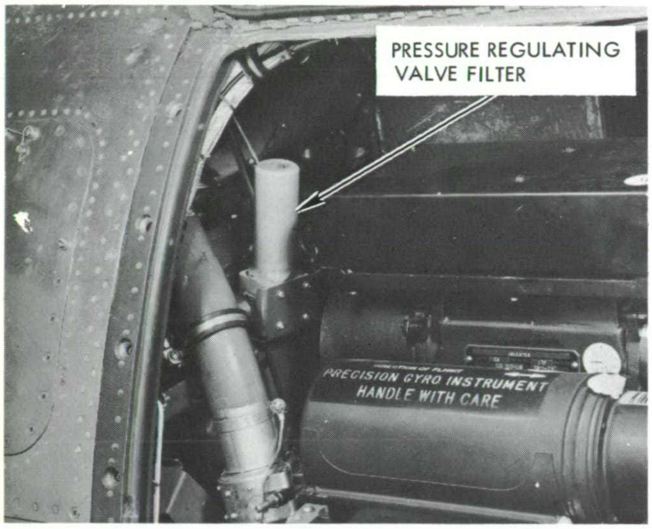


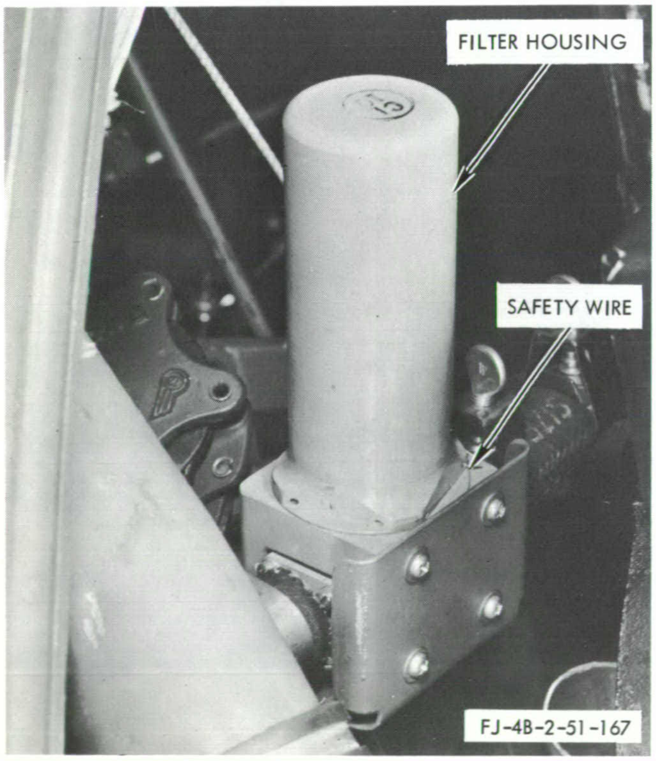
Figure No. 4-35. Anti-G Suit Pressure Regulating Valve Filter

4-150. REMOVING AND INSTALLING PRESSURE REGULATING VALVE FILTER ELEMENT.



REMOVING

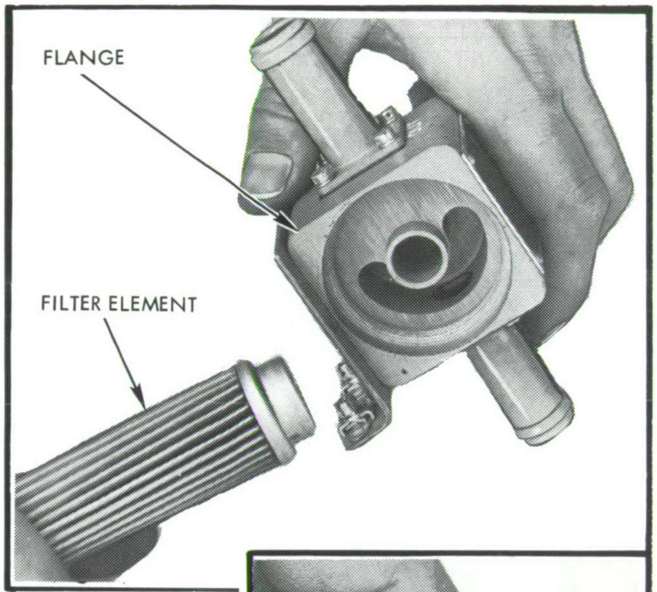
1. Open radio bay access door on left side of forward fuselage.
2. Remove safety wire from filter housing to base of filter.
3. Unscrew filter housing from base and remove "O" ring and filter element.



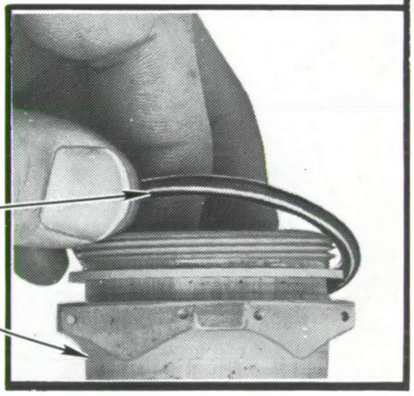
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INSTALLING

1. Position end of new filter element over flange in base of filter.

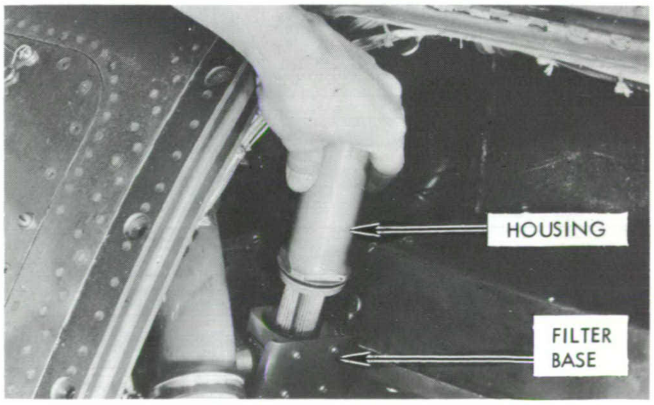


2. Install "O" ring on groove on end of filter housing.



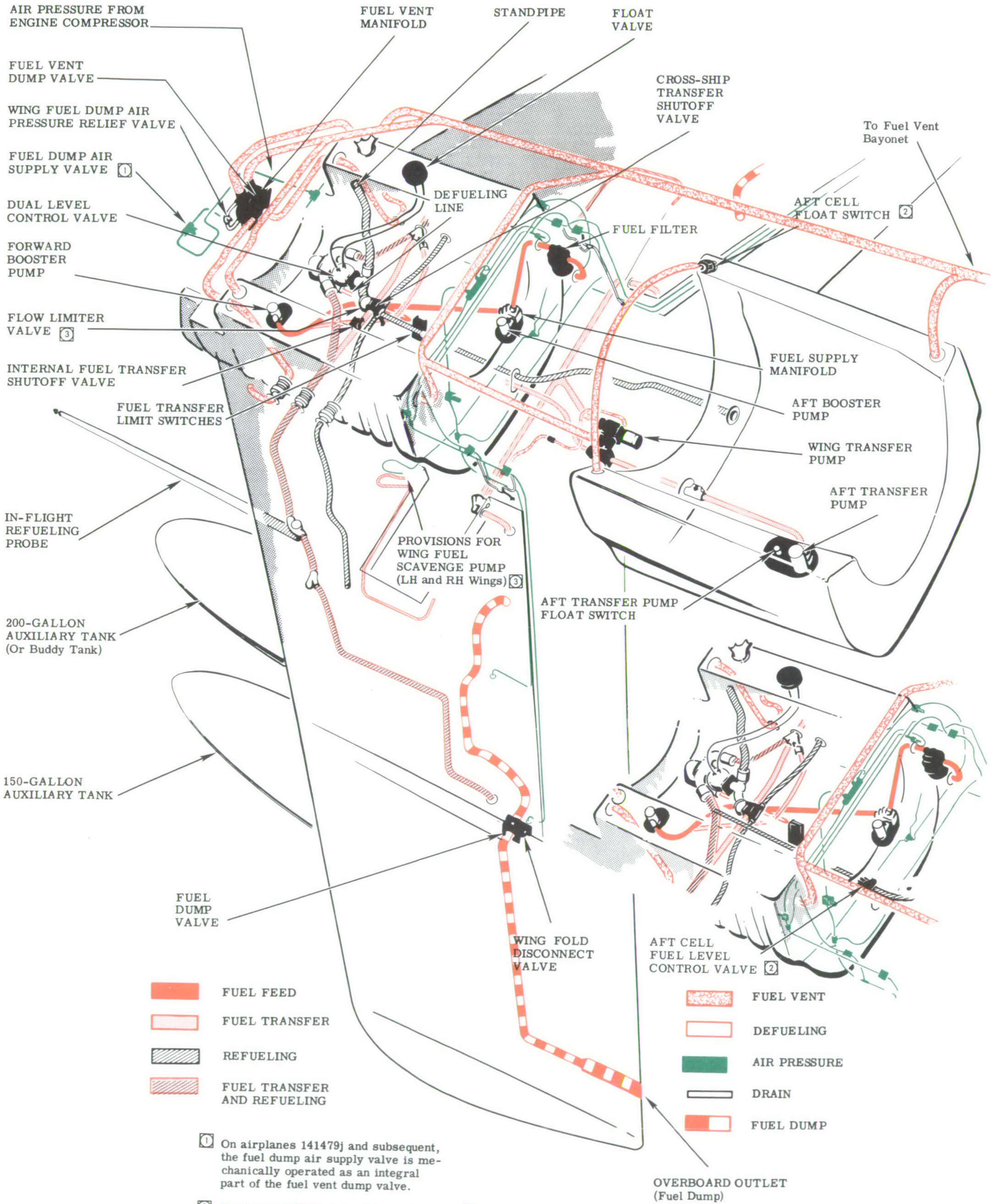
3. Install filter housing over filter base and screw down tightly using hands only.

Caution Do not use a wrench to tighten filter housing into filter base.



4. Safety filter housing to filter base with AN995F32 safety wire.
5. Close radio bay access door.

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1 On airplanes 141479j and subsequent, the fuel dump air supply valve is mechanically operated as an integral part of the fuel vent dump valve.

2 Airplanes 143543l and subsequent

3 Airplanes 139531i through 143542k

Figure No. 4-36. Fuel System

FUEL SYSTEM

4-151. FUEL SYSTEM.

4-152. The fuel system for the FJ-4B (figure 4-36) is designed to provide fuel to the J65 axial flow turbojet engine. (For correct grade of fuel, refer to paragraph 1-34.) The internal fuel is contained in two U-shaped fuselage cells and two integral wing tanks. Auxiliary fuel is contained in two external 200-gallon, droppable fuel tanks, located at the intermediate stores station under each wing, and/or two 150-gallon, droppable fuel tanks located at the outboard stores station under each wing. Auxiliary fuel also may be contained in the in-flight refueling tanker package (buddy tanker). The fuel system consists of two booster pumps, two transfer pumps, a fuel filter, an electrically operated fuel shutoff valve, a manually operated wing fuel vent shutoff valve and a manually operated fuel dump air supply valve (combined in one housing on airplanes 141479j and subsequent), two manually operated wing fuel dump valves, an electrically operated internal fuel transfer shutoff valve to provide fuel transfer to the in-flight refueling tanker package and a cross ship fuel transfer shutoff valve to provide fuel transfer from the buddy fuel tank to the buddy reel tank, a dual level control valve and dual level float valve, fuel level and transfer control float switches, a flow limiter valve (on airplanes 139531i through 143542k), check valves and the necessary fuel feed and vent lines. Normally, fuel is transferred at the appropriate time from the wing tanks and the aft cell by the aft and wing fuel transfer pumps due to transfer pump sequencing which is controlled by the fuel transfer system (paragraph 4-175). In the event of a pump failure, fuel will flow by gravity to the forward fuselage cell from the wing tanks and aft fuel cells. On airplanes 139531i through 143542k, provisions are incorporated for a wing fuel scavenge pump in each wing integral fuel tank slightly forward of the landing gear housing next to the wing root (figure 4-37). These provisions consist of a relay, a solenoid shutoff valve and numerous lines and fittings. The scavenge pumps are not installed in the airplane. Fuel is delivered to the engine by the fuel feed system (paragraph 4-160) consisting of two submerged booster pumps in the forward fuselage cell through two lines to a manifold also located in the forward cell. The manifold incorporates three check valves; one valve in each pump line prevents reverse flow in the event one pump fails and the remaining valves provide a suction feed from the engine fuel pumps should both booster pumps fail. The fuel then flows to the fuel shutoff valve, through the low-pressure fuel filter, and into the engine-driven fuel pump. The fuel vent system (paragraph 4-203), consists of two U-shaped fuselage cells which are vented for climb at both top forward corners to relieve positive pressures. A dive vent is provided by a connection at the rear of each fuselage cell to relieve negative pressures. Dive and climb venting of the wing tanks is accomplished through the same lines used for climb venting of the fuselage tanks. The wing fuel dump system (paragraph 4-206) consists of a fuel dump line running outboard from the wing sump area of each wing through a manually operated shutoff valve, through a wing fold mechanism and out to the outboard trailing edge of the wing. High-pressure air is supplied by the heat and vent system and is regulated by the use of two flow orifices and a pressure relief valve. When the buddy tanks are installed, fuel can be transferred from the airplane's internal fuel system by the operation of an electrically operated valve mounted in the transfer line between the forward fuel booster pump supply line and the drop tank transfer line. Buddy tank fuel also may be transferred to the airplane's internal fuel system by the drop tank transfer lines and through the refueling system. Buddy tank fuel transfer from the left to the right tank is accomplished through use of the drop tank crossover line in the forward fuselage cell which incorporates an electrically operated shutoff valve.

4-153. FUNCTION OF FUEL SYSTEM.

4-154. When the ENGINE MASTER switch (located on the left-hand forward console) is actuated to the "MASTER" position, the master fuel shutoff valve is energized to the open position and the aft fuel booster pump relay is energized, thus energizing the aft booster pump in the forward fuel cell (figure 4-52). The forward booster pump relay is energized only when the landing gear downlock relay is energized (landing gear in the up position) or by actuating the booster pump test switch (BOOST PUMP TEST). The two booster pumps, when energized, supply fuel to the engine fuel regulation system through the fuel shutoff valve and filter (figure 4-37). The wing fuel transfer pump and the aft fuel cell transfer pump are controlled by a fuel level control transfer system (steps o. and p., paragraph 4-157). This system consists of a series of float switches which control the cycling of the transfer pumps through the transfer pump relays (figure 4-57). The automatic cycling of the transfer pumps may be overridden manually by the emergency transfer fuel control switch (EMERG TRANSFER FUEL CONTROL) on the left-hand forward console. This three-position switch energizes the wing transfer pump when positioned to "WING TANK," energizes the aft transfer pump when positioned to "AFT TANK" and, when positioned to "AUTOMATIC," cycles the transfer pump switches, according to the fuel level in the forward cell (which automatically will transfer fuel from the wings and the aft fuel cells to the forward cell). The

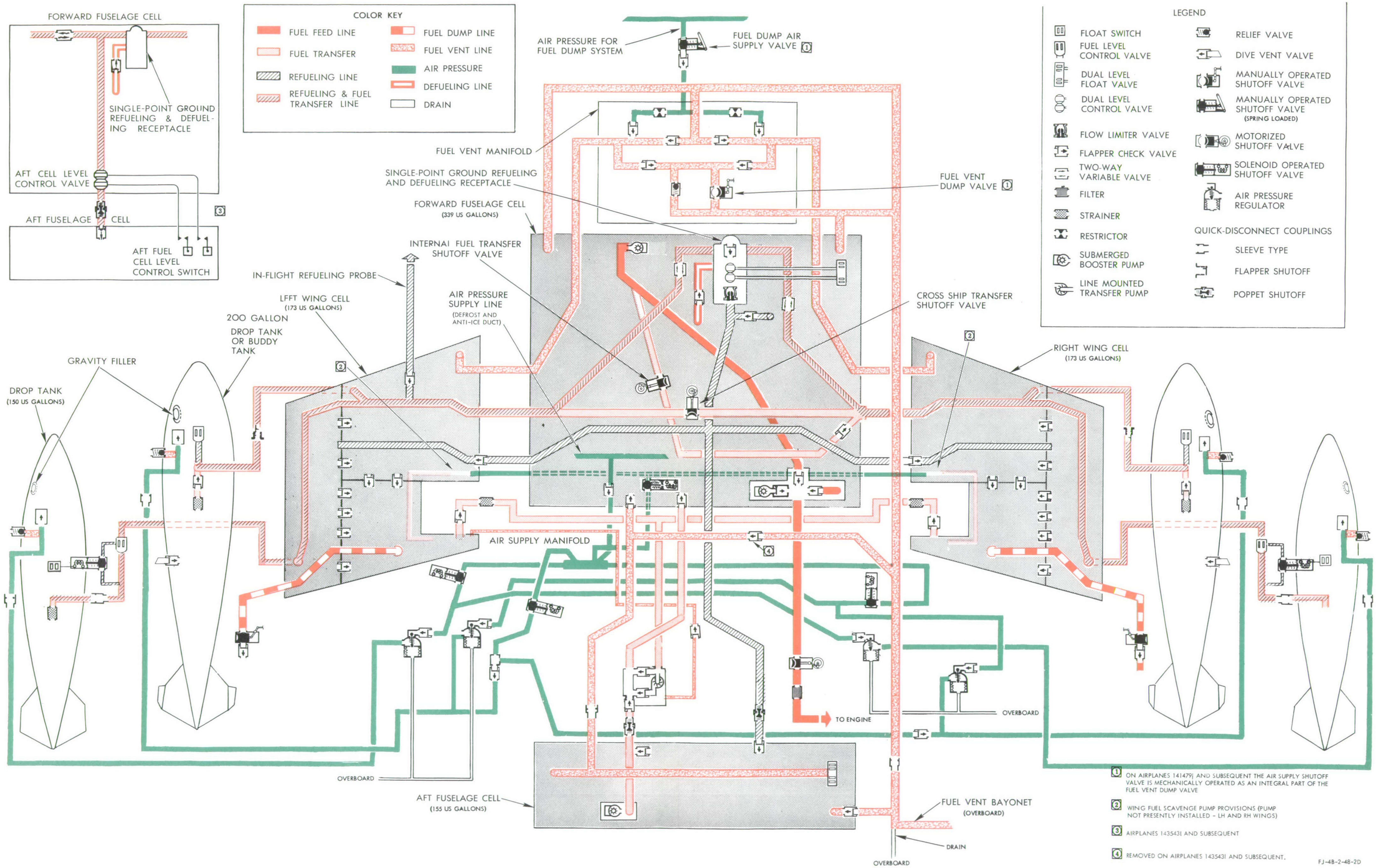


Figure No. 4-37. Fuel System—Schematic

lowest mounted switch illuminates the low fuel warning light at any time the fuel level is below the float-type switch. If the buddy tanks are installed, the low level switch will close the internal fuel transfer valve when the low fuel sensing relay (figure 4-57) is de-energized, preventing the transfer of a predetermined amount of fuel from the airplane's fuel system to the buddy tanks. This transfer of fuel ensures that a safe fuel supply remains for airplane operation. When the buddy tanks are installed, fuel may be transferred to the airplane's internal fuel system by the same method as auxiliary fuel. (Refer to paragraph 4-237.) When the INTERNAL FUEL TRANS or the CROSS SHIP FUEL TRANS switch (left-hand radio bay) is positioned to "CLOSE & TEST," power is applied from the secondary bus to close the valves. A valve closed light will illuminate when either valve is full closed while holding the appropriate switch to "CLOSE & TEST." When the wing fuel dump handle is pulled to the fuel dump position, full outward (figure 4-62), the fuel vent shutoff valve, mounted on the fuel vent manifold in the radio bay, will move to the full closed position and, through linkage, will open the fuel dump air supply shutoff valve. The cable action will also actuate the fuel dump shutoff valves located at the wing fold break. Then, fuel will dump from the wing fuel dump scarfed outlets near the outboard tip of each wing. Depressing the TRANSFER PUMP TEST switch, located on the aft canopy deck, to either the "AFT" or the "WING" position will energize the aft or forward fuel transfer pump relay and, in turn, will energize the aft or wing transfer pump. Positioning the dual level float valve test switch, located beside the single-point refueling receptacle, to "PRIMARY" or "SECONDARY" will close one of the pilot valves (figure 4-65) and, through sensing line action, the fuel level control valve will close, shutting off the incoming fuel.

Note

- On airplanes 139531i through 141466j, it is necessary to energize the primary bus to test the fuel system float level shutoff valves, including those in the buddy tanker, for proper operation. The primary bus can be energized in three ways: (1) by battery power, (2) by external power, or (3) by generator power. During normal refueling operations the D.C. POWER switch is placed to the "BAT. & GEN" position to energize the primary bus by the battery. Also on these airplanes, both left- and right-hand buddy tank float level shutoff valves are tested simultaneously when the "PRIMARY" position of the dual level control valve TEST switch is selected.
- On airplanes 141467j and subsequent, the battery bus supplies power to test all float level shutoff valves. The battery bus is energized whenever the battery is installed and connected. The D.C. POWER switch need not be in any particular position in order to test the float level shutoff valves. Also, on this latter block of airplanes, the buddy tank float level shutoff valves have their own test switch in the single-point well. The buddy tank float level shutoff valve is not tested by the dual level control valve test switch on these airplanes.

On airplanes 139531i and subsequent, the solenoid-operated shutoff valve, used for single-point and in-flight refueling of the 150-gallon auxiliary tanks (located in the outboard pylons) will open when the D.C. POWER switch is in the "BAT. & GEN" position, the DROP TANK FUEL TRANSFER switch is in the "OFF" position and the 150-gallon tank float switch is closed. On airplanes 141467j and subsequent, a 150-gallon tank refuel switch (located in the single-point access) is provided to by-pass the drop tank transfer switch (during single-point refueling) and energize the solenoid-operated shutoff valve from the battery bus in lieu of the primary bus. On airplanes 143543l and subsequent, the refuel switch also energizes the aft fuel cell float level shutoff valve with power from the battery bus. (Refer to paragraph 4-210.) On airplanes 143543l and subsequent, an aft cell level control valve test switch must also be positioned to "PRIMARY" or "SECONDARY" to determine whether the level control is functioning properly. (Refer to paragraph 4-216.) The defueling switch, when depressed, will energize the aft and wing fuel transfer pump relays (by-passing the ENGINE MASTER switch) and, in turn, the transfer pumps will be energized automatically by the sequencing of the float switches to provide the transfer of fuel to the forward cell for defueling.

4-155. TROUBLE SHOOTING FUEL SYSTEM.

GENERAL

TEST EQUIPMENT: Torque wrench.

SYSTEM CONDITION: Neutral (no electrical power).

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
LEAKAGE FROM FUEL LINE CONNECTIONS.			
Line coupling improperly installed.	Disassemble coupling and visually inspect for defective "O" rings, defective sleeve seals or improper installation.		Replace faulty "O" rings or sleeve seals. Install coupling correctly. (See figures 4-7 and 4-8.)
FUEL LEAKAGE AROUND FUEL CELL ACCESS DOORS OR CELL UNITS.			
"O" ring improperly installed or not installed in cell fitting.	Remove and visually inspect for "O" ring and condition of "O" ring.		Properly install "O" ring. (See figure 4-7.)
Faulty fuel cell fitting.	Visually inspect fitting for imperfections.		Replace fitting or cell.
Faulty fuel cell.	Pressure check fuel system (paragraph 4-158.)		Replace fuel cell if faulty.
Attaching bolts undertorqued.	Check for proper torque setting.		Properly torque.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
FUEL RUNS OVERBOARD THROUGH VENT LINES.			
Thermal expansion of fuel.			Drain some fuel from airplane. (Refer to paragraph 1-35.)
Faulty fuel level control valve or valves and/or faulty float valve.	Check operation during single-point refueling (paragraph 4-216).		Replace valve or valves.

FUEL FEED SYSTEM

TEST EQUIPMENT: D-C voltmeter.

SYSTEM CONDITIONS: 28-Volt d-c power applied to airplane.
MASTER FUEL SHUT OFF & TRANSFER TEST and AFT FUEL BOOST PUMP circuit breakers engaged.
ENGINE MASTER switch to "MASTER" position.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO FUEL AVAILABLE TO ENGINE (AIRPLANE ON GROUND).			
Fuel shutoff valve inoperative.	Visual check of valve indicator.	None.	If valve is open, trouble shoot fuel booster pumps. If valve is closed, continue trouble shooting.
	Check between test point QA and ground.	28 volts dc.	Replace fuel shutoff valve.
		Other than 28 volts dc.	Continue trouble shooting.
	Check between test point QB and ground.	28 volts dc.	Replace defective wire segment to test point QA.
		Other than 28 volts dc.	Replace defective ENGINE MASTER switch or attached power wire.
Aft booster pump inoperative.	Position BOOST PUMP TEST switch to "AFT."	None.	If pump operates, check AFT FUEL BOOST PUMP relay ground control circuit. If pump fails to operate, continue trouble shooting.
	Check between test point QBA and ground.	28 volts dc.	Replace defective aft fuel booster pump.
		Other than 28 volts dc.	Continue trouble shooting.
	Check between test points QBB, QBC and ground. Check between test points QBC and QBD.	28 volts dc.	Replace defective wire to test point QBA.
		Other than 28 volts dc at test point QBB.	Replace defective AFT FUEL BOOST PUMP relay.
		Other than 28 volts dc at test point QBC.	Replace defective power wire.
		Other than 28 volts dc between test points QBC and QBD.	Replace defective ENGINE MASTER switch or attached wiring.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
FUEL FLOW FAILS TO CEASE WHEN CHECKING "PRIMARY" OR "SECONDARY" POSITION OF FORWARD CELL DUAL LEVEL CONTROL VALVE TEST SWITCH.			
Defective dual level float valve.	With TEST switch in "PRIMARY" position, check between test point QRA and ground. With TEST switch in "SECONDARY" position, check between test point QRB and ground.	28 volts dc.	Replace defective float valve.
		Other than 28 volts dc.	Continue trouble shooting.
Defective test switch or wiring.	Check between test point QRC and ground.	28 volts dc.	Replace defective test switch or wires to float valve.
		Other than 28 volts dc.	Continue trouble shooting.
Defective circuit breaker.	Check between test point PGQ and ground.	28 volts dc.	Replace defective circuit breaker.
		Other than 28 volts dc.	Refer to paragraph 8-60, Trouble Shooting D-C Power Distribution System.

REFUELING SYSTEM (AIRPLANES 141467j THROUGH 143542k)

TEST EQUIPMENT: D-C voltmeter.

SYSTEM CONDITIONS: 28-Volt d-c power applied to airplane.
FLOAT TEST & DROP TANK REFUEL circuit breaker engaged.
Airplane in process of being refueled (single-point).

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
FUEL FLOW FAILS TO CEASE WHEN CHECKING "PRIMARY" OR "SECONDARY" POSITION OF FORWARD CELL DUAL LEVEL CONTROL VALVE TEST SWITCH.			
Defective dual level float valve.	With TEST switch in "PRIMARY" position, check between test point QRA and ground. With TEST switch in "SECONDARY" position, check between test point QRB and ground.	28 volts dc.	Replace defective float valve.
		Other than 28 volts dc.	Continue trouble shooting.
Defective DUAL LEVEL FLOAT TEST relay, TEST switch or defective attached wiring.	With TEST switch positioned to "PRIMARY," check between test points QRG, QRH and ground. With TEST switch positioned to "SECONDARY," check between test points QRH, QRJ and ground.	28 volts dc.	Replace defective relay.
		Other than 28 volts dc at test point QRG, QRH or QRJ.	Replace defective TEST switch or attached wiring.
Defective circuit breaker.	Check between test point PGZ and ground.	28 volts dc.	Replace defective circuit breaker.
		Other than 28 volts dc.	Refer to paragraph 8-60, Trouble Shooting D-C Power Distribution System.

REFUELING SYSTEM (AIRPLANES 143543l AND SUBSEQUENT)

TEST EQUIPMENT: D-C voltmeter.

SYSTEM CONDITIONS: 28-Volt d-c power applied to airplane.
FLOAT TEST & DROP TANK REFUEL circuit breaker engaged.
Airplane in process of being refueled (single-point).

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
FUEL FLOW FAILS TO CEASE WHEN CHECKING "PRIMARY" OR "SECONDARY" POSITION OF FORWARD CELL DUAL LEVEL CONTROL VALVE TEST SWITCH.			
Defective dual level float valve.	With TEST switch in "PRIMARY" position, check between test point QRA and ground. With TEST switch in "SECONDARY" position, check between test point QRB and ground.	28 volts dc.	Replace defective float valve.
		Other than 28 volts dc.	Continue trouble shooting.
Defective dual level and buddy tank float test relay, TEST switch or defective attached wiring.	With TEST switch positioned to "PRIMARY," check between test points QRP, QRQ and ground. With TEST switch positioned to "SECONDARY," check between test points QRQ, QRR and ground.	28 volts dc.	Replace defective relay.
		Other than 28 volts dc at test points QRP, QRQ and QRR.	Replace defective TEST switch or attached wiring.
Defective circuit breaker.	Check between test point PGZ and ground.	28 volts dc.	Replace defective circuit breaker.
		Other than 28 volts dc.	Refer to paragraph 8-60, Trouble Shooting D-C Power Distribution System.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.
AFT FUEL SHUT OFF and REFUEL circuit breakers engaged.
Airplane in process of being refueled (single-point).

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
FUEL FLOW FAILS TO CEASE WHEN CHECKING "PRIMARY" POSITION OR SLOW DOWN WHEN CHECKING "SECONDARY" POSITION OF AFT CELL DUAL LEVEL CONTROL VALVE TEST SWITCH ON AIRPLANES 143543I AND SUBSEQUENT.			
Defective aft cell dual level shutoff valve.	With TEST switch in "PRIMARY" position, check between test point QRU and ground. With TEST switch in "SECONDARY" position, check between test point QRV and ground.	28 volts dc.	Replace defective shutoff valve.
		Other than 28 volts dc.	Continue trouble shooting.
Defective PRI. AFT CELL SHUT OFF RELAY.	With TEST switch in "PRIMARY" position, check between test points QRW, QRX and QRY and ground and between test points QRY and QRZ.	28 volts dc at all points.	Replace defective wire to test point QRU.
		Zero volts at test point QRW.	Replace defective PRI. AFT CELL SHUT OFF RELAY.
		Zero volts at test point QRX.	Replace defective wire segment to test point QRY.
		28 volts dc between test point QRY and ground and between test points QRY and QRZ.	Replace defective PRI. AFT CELL SHUT OFF RELAY.
		Zero volts at test point QRY or zero volts between test points QRY and QRZ.	Continue trouble shooting.

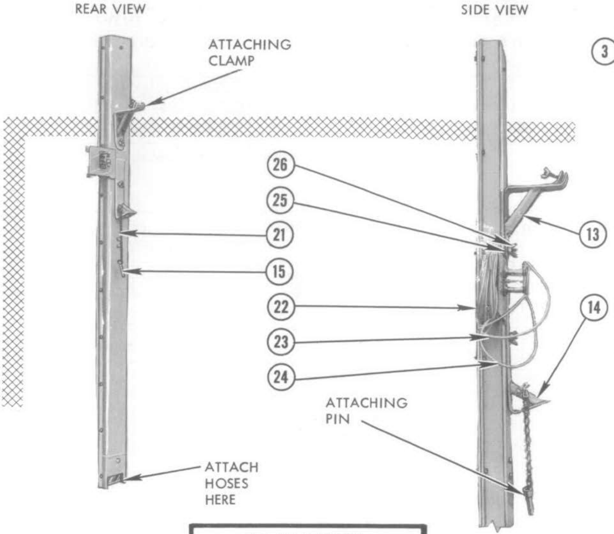
PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
FUEL FLOW FAILS TO CEASE WHEN CHECKING "PRIMARY" POSITION OR SLOW DOWN WHEN CHECKING "SECONDARY" POSITION OF AFT CELL DUAL LEVEL CONTROL VALVE TEST SWITCH ON AIRPLANES 143543I AND SUBSEQUENT. (Cont)			
Defective AFT CELL FLOAT TEST RELAY or aft cell float TEST switch.	With TEST switch in "PRIMARY" position, check between test points QSE, QSF and ground.	28 volts dc.	Replace defective AFT CELL FLOAT TEST RELAY or attached wiring.
		Other than 28 volts dc at test point QSE or QSF.	Replace defective power wire.
Defective SEC AFT CELL SHUT OFF RELAY.	With TEST switch in "SECONDARY" position, check between test points QSA, QSB, QSC and ground and between test points QSC and QSD.	28 volts dc at all points.	Replace defective wire to test point QRV.
		Zero volts at test point QSA.	Replace defective SEC AFT CELL SHUT OFF RELAY.
		Zero volts at test point QSB.	Replace defective wire segment to test point QSE.
		28 volts dc between test point QSE and ground and between test points QSE and QSD.	Replace defective SEC AFT CELL SHUT OFF RELAY.
		Zero volts at test point QSC or zero volts between test points QSC and QSD.	Continue trouble shooting.
Defective AFT CELL FLOAT TEST RELAY or aft cell float TEST switch.	With TEST switch in "SECONDARY" position, check between test points QSG, QSF and ground.	28 volts dc.	Replace defective AFT CELL FLOAT TEST RELAY or attached wiring.
		Other than 28 volts dc at test point QSG or QSF.	Replace defective power wire.

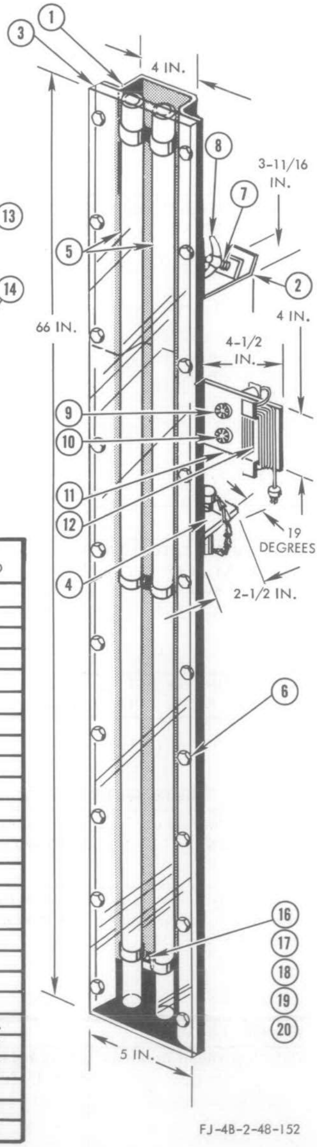
FUEL FLOW TO AFT CELL FAILS TO CEASE WHEN CELL IS FULL (DETERMINED BY OVERBOARDING OF FUEL FROM FUEL VENT BAYONET OR FUEL VENT DRAIN).

CAUTION

Immediately cease refueling of the airplane or damage to the fuel cell could result.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
Defective aft fuel cell float switch.	Check between test points QSH, QSJ and ground.	28 volts dc.	Replace defective float switch or wiring to switch.
		Zero volts.	Continue trouble shooting.
Defective AFT CELL FLOAT TEST RELAY or outboard drop tanks switch.	Check between test point QSK and ground.	28 volts dc.	Replace defective AFT FLOAT TEST RELAY or attached wiring.
		Other than 28 volts dc.	Replace defective outboard drop tank switch or attached wiring.
POWER FAILURE.			
Defective circuit breakers.	Check between test points PGV, PGAA and ground.	28 volts dc.	Replace defective circuit breakers.
		Other than 28 volts dc.	Refer to paragraph 8-60, Trouble Shooting D-C Power Distribution System.





BILL OF MATERIALS

ITEM	DESCRIPTION	SIZE OR PART NO.	AMT REQD
1	CASE - 6061-T AL ALLOY	5 x 1-1/4 x 66 x 0.081 IN.	1
2	BRACKET - 6061-T AL ALLOY	1-1/2 x 10-1/8 x 0.125 IN.	1
3	COVER - PLEXIGLAS	5 x 3/16 x 66 IN.	1
4	BRACKET - 6061-T AL ALLOY	1-1/2 x 11 x 0.125 IN.	1
5	TUBE - GLASS	3/4 OD x 65 IN.	2
6	BOLT	1/8 DIA x 1/2 LG (IN.)	20
7	BOLT - STUD	NO. 10 (.190) 24NC x 1 LG (IN.)	1
8	WING - NUT	AN350-1032	1
9	INDICATOR LIGHT - RED	DRAKE NO. 20	1
10	INDICATOR LIGHT - GREEN	DRAKE NO. 20	1
11	PANEL - 6061-T AL ALLOY	4 x 5 x 0.125 IN.	1
12	BRACKET - WIRE	1/8 DIA x 2-1/2 IN.	2
13	BRACE - 6061-T AL ALLOY	2 x 0.125 x 4-1/4 IN.	1
14	BRACE - 6061-T AL ALLOY	2 x 0.125 x 2-1/2 IN.	1
15	PIN - STEEL	3/8 DIA x 2-1/2 LG (IN.)	1
16	MACHINE SCREW	AN520-10R12	3
17	NUT	AN365-1032	3
18	WASHER	2W18-416M	3
19	CLAMP	MS21919- OF 12	6
20	SPACER	NAS43-3-16	3
21	CHAIN - BRASS	NO. 30	8 IN.
22	WIRE - INSULATED ELECTRICAL NO. 18 RED COLOR CODED		10 FT
23	WIRE - INSULATED ELECTRICAL NO. 18 GREEN COLOR CODED		10 FT
24	WIRE - INSULATED ELECTRICAL NO. 18 BLACK COLOR CODED		6 FT
25	BOLT	AN4-5	2
26	WING NUT	AN-350-4	2

Figure No. 4-38. Sight Gage

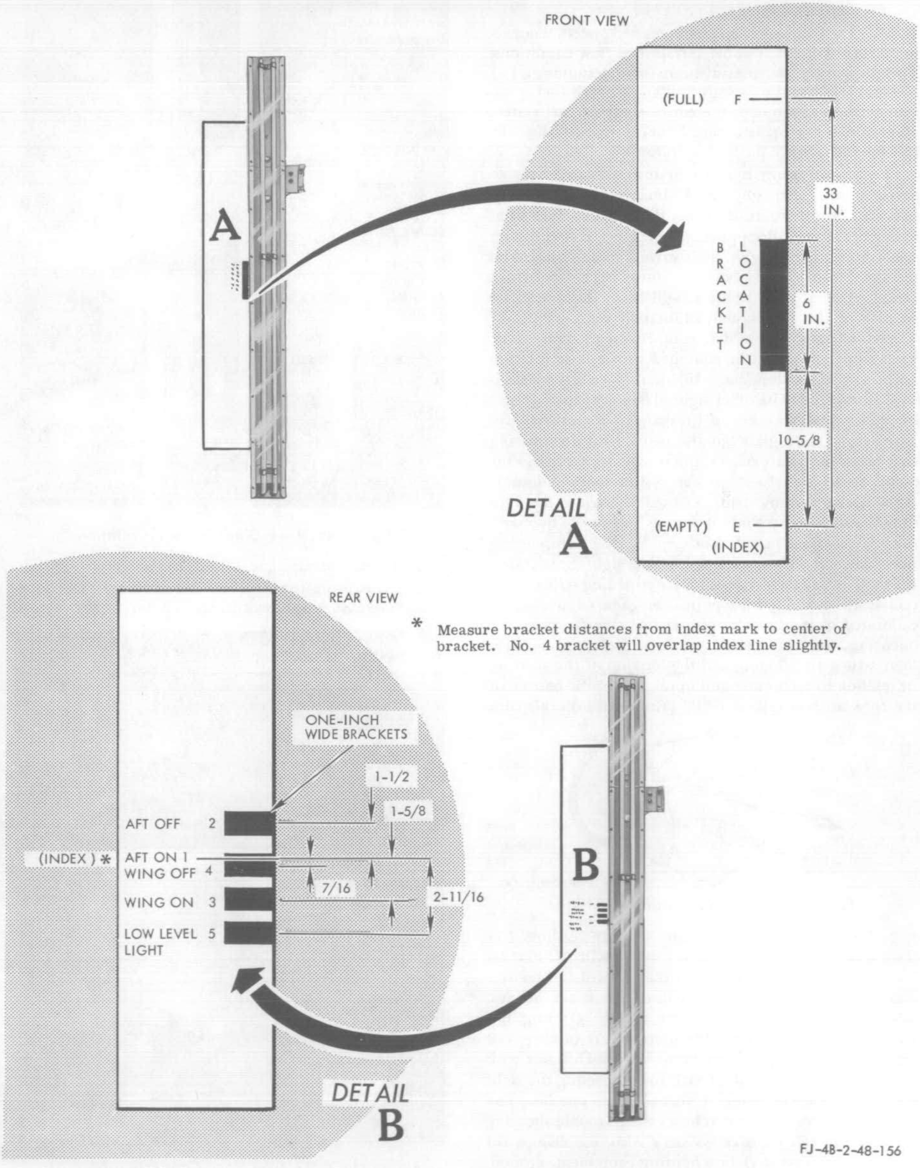


Figure No. 4-39. Stick Type Master Gage—Airplanes 139531i through 143542k

4-156. TESTING FUEL SYSTEM.

4-157. The following test simulates fuel system sequencing which will result under certain fuel flow conditions. This procedure provides a means of determining: (1) the fuel levels in the forward cell and (2) the fuel transfer schedule throughout the entire range of fuel system operation for a predetermined fuel flow condition. To test the fuel system, proceed as follows:

a. The following is a list of materials necessary to perform this test: (1) A $1\frac{1}{4}$-inch diameter hose of sufficient length to reach from the airplane fuel filter to the fuel truck filler opening. (2) A $1\frac{1}{4}$-inch diameter quick opening gate valve. This valve is to be installed on the hose from the airplane fuel filter to the fuel truck (step g.) at a point where it will be in the immediate vicinity of the fuel system calibration sight gage. (3) A two-tube sight gage unit conforming to figure 4-38. Each sight glass must be equipped with a hose for connection with the designated fuel tank. One sight glass is used in this test. The other sight glass is a spare that may be readily used in event of breakage of the other glass. This second sight glass can also be used for determining fuel levels in the aft cell (while trouble shooting) in the event of aft cell fuel transfer system malfunctioning. An acetate recording strip, mounted adjacent to the sight tubes, is used for recording various fuel levels by marking with a grease pencil. Also, two transfer pump operation indicator lights, mounted on the sight gage frame, are used as signals for marking the recording strip during fuel tests. (4) A stick-type master gage (figure 4-39), calibrated to indicate the proper fuel transfer pump sequencing, the float switch and low level warning light float switch functioning and the location of the switches in relation to each other and in relation to the bottom of the forward fuel cell. The "F" (full) mark on this stick

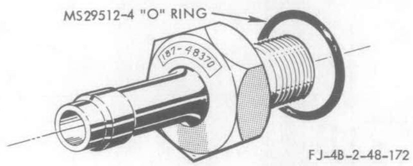


Figure No. 4-40. Hose Adapter Fitting

gage indicates the minimum fuel capacity reading. (5) Two hose adapter fittings (figure 4-40), with MS19512-4 "O" rings used for insertion in the forward cell booster pump and aft cell transfer pump fuel drain fittings. (Normally, use one hose adapter and an "O" ring, but use two fittings when trouble shooting aft fuselage cell transfer system.) (6) Two 11/64-inch I. D. hoses with a shutoff valve installed on each for connecting the sight gages to the forward cell. (Normally, use one hose and a shutoff valve, but use two hoses when trouble shooting aft fuselage cell transfer system.) Also, use clamps for securing the hose. (7) Fire-fighting equipment, grounding wires, etc, as specified by regulations.

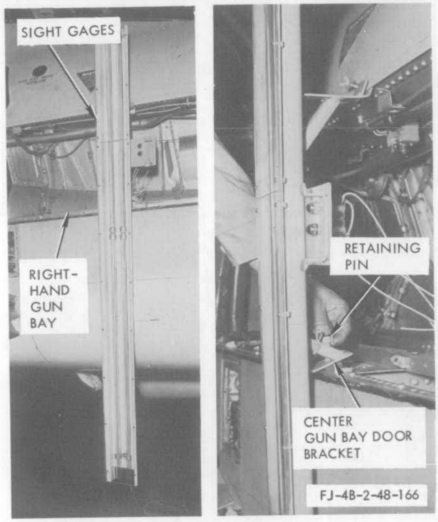


Figure No. 4-41. Sight Gage Installation

b. Defuel the airplane. (Refer to paragraph 1-35.)

c. Replace the forward fuel cell aft boost pump fuel drain valve with a hose adapter. (Refer to step a., 5.)

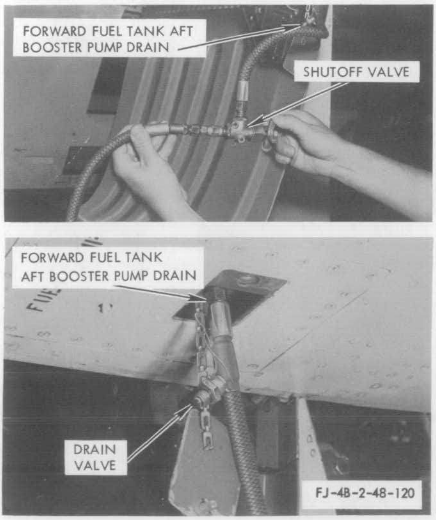


Figure No. 4-42. Fuel Hose Connection from Aft Booster Pump Fuel Drain to Forward Sight Gage Tube

d. Remove the right-hand gun bay access door (figure 4-41) and attach the fuel level indicating sight gage to the gun bay center latch pin hole. (Refer to step a., 5.)

Note

Ensure that all grease pencil marks on the sight gage fuel level recording panel have been erased.

e. Connect a hose between the forward tank sight gage and the forward fuel tank aft booster pump fuel drain (figure 4-42); close the shutoff valve installed in this line. (If test of aft cell transfer system is to be performed, connect a hose between the aft tank sight gage and the aft tank fuel drain.)

f. Connect the fuel transfer pump operation indicator lights, located on the right side of the sight gages, to the fuel transfer pump control circuit (figure 4-43) as follows: (1) Open the right-hand radio bay access cover and remove the electrical relay junction box cover. (2) Connect one lead from the red light to the aft transfer pump relay (relay number 7) at terminal "A2" and attach one lead from the green light to the wing transfer pump relay (relay number 11) at terminal "A2." (3) Connect the remaining lead from each light to a common ground.

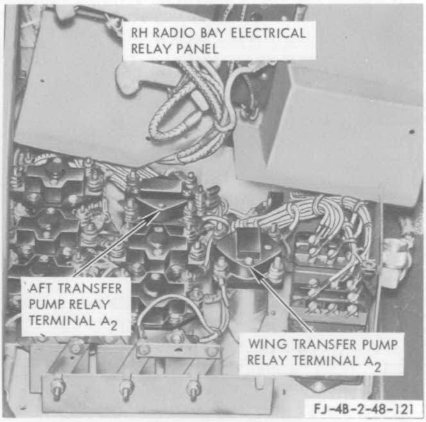


Figure No. 4-43. Fuel Transfer Pump Indicator Light Connections

g. Open the engine access door on the right-hand side of the fuselage (figure 4-44), disconnect the engine fuel feed line on the downstream side of the airplane fuel filter and connect the fuel feed extension hose (step a., 1), incorporating the quick opening gate valve (step a., 2). Place the free end of this hose in the fuel drain truck tank filler.

h. Refuel the airplane. (Refer to paragraph 1-34.) Be sure a minimum of 820 gallons of fuel was added to the airplane fuel system (without auxiliary tanks).

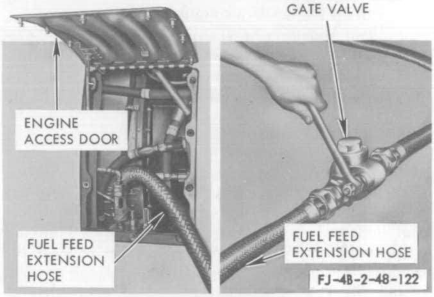


Figure No. 4-44. Fuel Feed Extension Hose from Fuel Filter to Fuel Truck

i. Position the airplane in the normal flight attitude (4 degrees nose-up) and level the wings laterally. (Refer to paragraph 1-16.) The use of airplane jacks is recommended to accomplish this procedure.

j. Remove two bolts from base of nose gear downlock switch and permit the switch to close. This will allow the forward boost pump to operate during the test.

k. Connect a 28-volt d-c power source to the 28-volt d-c power receptacle and position INST. AC POWER switch at "NO. 1 INV."

WARNING

Place the d-c power switch in the "OFF" position while servicing the airplane with 28-volt external power.

l. Open the sight gage hose shutoff valve (figure 4-42) and allow the fuel level to stabilize in the sight gage tube.

m. Individually actuate each booster pump test switch (paragraph 4-166) while the ENGINE MASTER switch is positioned at "OFF" and the fuel flow valve on the fuel discharge hose is open. Be sure each booster pump operates and that no fuel flows from the fuel feed line extension hose. This indicates that the main fuel shutoff valve closes properly.

n. Fuel is to be pumped from the airplane fuel system into a fuel truck through a hose connected to the engine fuel feed line. The rate of fuel flow may be controlled manually by a valve installed in the fuel feed line extension hose. A sight gage, connected to the forward (sump) cell, indicates fuel levels in the cell. A markable acetate strip, adjacent to the sight tube, may be used to record the fuel levels. This can be accomplished by using grease pencil to mark the five different levels as shown in the chart (figure 4-39). Successful performance of the following portion of this test is dependent upon proper operation of the fuel flow control valve. Step o. explains the function of the fuel flow test and the chart in step p. outlines each procedure as it takes place. After reading

step o. and using it as a reference, begin the fuel flow test with sequence No. 1 in the sequencing chart while following the REMARKS column closely.

o. (Test function of fuel sequencing system to be performed in step n.) With the ENGINE MASTER switch "ON" and the booster pumps operating (in this test the fuel is routed to the fuel drain truck to simulate the engine running and consuming fuel), the following sequence will take place in the fuel transfer system: (1) When the fuel level of the forward fuselage cell is lowered to within 15.9 inches (201 gallons) from the bottom of the forward fuselage cell [34.5 inches (336 gallons) on airplanes 143543l and subsequent], the No. 2 fuel level limit switch is actuated and completes a ground to the holding relay. (2) When the fuel level of the forward fuselage cell is lowered (by fuel being pumped to the drain truck simulating engine operation) to within 14.4 inches (186 gallons) from the bottom of the forward fuselage cell [32.0 inches (325 gallons) on airplanes 143543l and subsequent], the No. 1 fuel level limit switch (step m.) will be actuated by the designed float action of the switch. The aft fuselage tank fuel transfer pump will start operating. [The fuel quantity indicator should show between 2190 and 2030 pounds of fuel when positioned to "SUMP" (marked on indicator face with yellow band).] This action also energizes the holding relay and completes the circuit to the No. 2 switch. When the fuel level in the forward fuselage cell reaches a height of 15.9 inches from the bottom of the forward fuselage cell (34.5 inches on airplanes 143543l and subsequent), the No. 2 fuel level limit switch will be deactuated and the aft fuselage tank fuel transfer pump will stop operating. This cycle may repeat itself several times until the aft fuselage fuel tank is empty (at which time the aft transfer pump will stop operating due to the action of the float shutoff switch in the aft fuselage cell). When the fuel level of the forward fuselage cell is lowered to within 14.1 inches (176 gallons) from the bottom of the cell, the No. 4 fuel level limit switch is actuated, completing a ground to the holding relay. When the fuel level of the forward fuselage cell is lowered to within 12.5 inches (161 gallons) from the bottom of the cell, the No. 3 fuel level limit switch will be actuated and the wing fuel transfer pump will start operating. [The fuel quantity indicator should show between 1000 and 1100 pounds of fuel when positioned to "SUMP" (marked on indicator face with yellow band).] Also, the holding relay is energized, completing the circuit to the No. 4 switch. As the fuel level in the forward fuselage cell increases to within 14.1 inches from the bottom of the cell, the No. 4 fuel level limit switch will be deactuated and the wing fuel transfer pump will stop operating. This cycle may repeat itself several times until the wing fuel tanks are empty. When the fuel level in the forward fuselage cell is lowered to within 11.5 inches (146 to 154 gallons) from the bottom of the cell, the No. 5 fuel level limit switch is actuated and the low level fuel warning light is illuminated.

p. To test fuel system sequencing, refer to the following chart:

TESTING FUEL SYSTEM — SEQUENCING

SEQUENCE NO.	FUEL FLOW CONTROL VALVE	MARK LEVEL OF FUEL (BESIDE SIGHT GAGES)	ILLUMINATION OF TEST LIGHTS	REMARKS
1.	CLOSED	F		Engage the following circuit breakers: "FWD FUEL BOOST PUMP," "AFT FUEL BOOST PUMP," "WING FUEL TRANSFER PUMP" and "AFT FUEL TRANSFER PUMP."
2.	OPEN			Position ENGINE MASTER switch "ON."
3.			RED	Position EMERG TRANSFER FUEL CONTROL switch to "AFT TANK."
4.			GREEN	Position EMERG TRANSFER FUEL CONTROL switch to "WING TANK." Return to "AUTOMATIC" after green light illuminates.
5.	CLOSED	1	RED	Fuel level in the sight gages should rise (close control valve immediately when red
6.		2	RED (out)	light illuminates) and the aft pump (sequence 6.) should stop operating within 30 to 60 seconds.
7.	OPEN (monitor valve)		RED	The fuel level should drop and the aft pump (red light) will start when the level drops to mark No. 1. Monitor the control valve (opening and closing) to maintain the

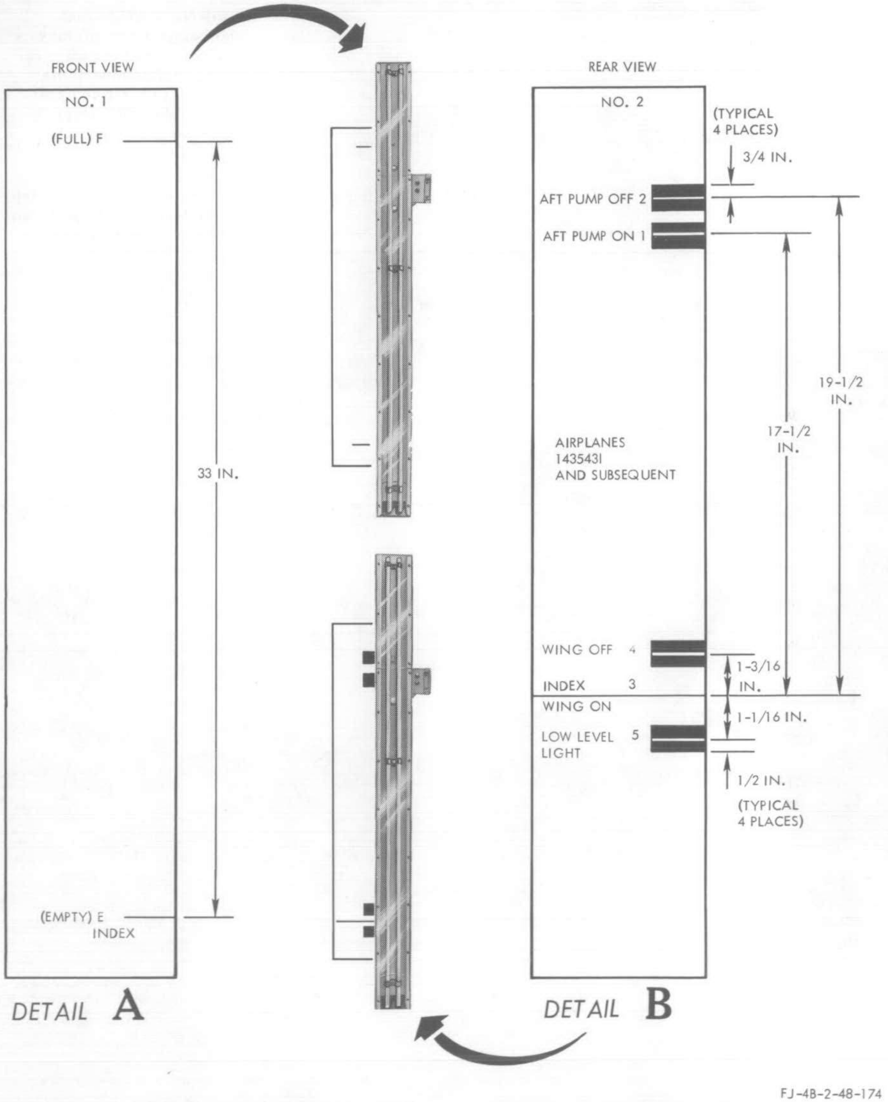


Figure No. 4-44A. Stick Type Master Gage—Airplanes 143543I and Subsequent

SEQUENCE NO.	FUEL FLOW CONTROL VALVE	MARK LEVEL OF FUEL (BESIDE SIGHT GAGES)	ILLUMINATION OF TEST LIGHTS	REMARKS
				level at mark No. 1. When fuel level in sight gage drops, aft tank is empty. (Physically check aft transfer pump to determine if the float switch in the aft cell shuts off the pump when the cell is empty.)
8.	CLOSED	3	GREEN	Close control valve immediately when green light illuminates and mark level No. 3. Fuel level in the
9.		4	GREEN (out)	sight gages should rise and the wing transfer pump (sequence 9.) will stop operating within 30 to 60 seconds.

SEQUENCE NO.	FUEL FLOW CONTROL VALVE	MARK LEVEL OF FUEL (BESIDE SIGHT GAGES)	ILLUMINATION OF TEST LIGHTS	REMARKS
10.	OPEN (monitor valve)		GREEN	The fuel level should drop and the wing transfer pump (green light) will start when the fuel level drops to mark No. 3. Monitor the control valve (opening and closing) to maintain the level at mark No. 3. When fuel level drops in sight gage, the wing tanks are empty.
11.		5	LOW LEVEL (cockpit)	The fuel quantity gage (in cockpit) should show between 850 and 1000 pounds when "SUMP" position is selected.
12.		E		Fuel flow stops (system empty).

q. Place the ENGINE MASTER switch in the "OFF" position and remove external power source.

r. The following chart shows the transfer pump and low level warning light status for each mark on the recording strip. (See figure 4-39.)

TRANSFER PUMP AND LOW LEVEL WARNING STATUS

RECORDING STRIP NO.	PUMP STATUS	PUMP INDICATING LIGHT	
		RED	GREEN
1.	Aft pump starts running.	ON	
2.	Aft pump stops running.	OFF	
3.	Wing pump starts running.		ON
4.	Wing pump stops running.		OFF
5.	Low level fuel warning light illuminates.	Cockpit low level fuel warning light "ON."	

s. Place the stick-type master gage (figure 4-39) (figure 4-44A for airplanes 143543l and subsequent) next to the fuel level recording strip using the No. 1 side and line up index mark "E" on the gage with the corresponding mark on the recording strip. The upper group of marks on the strip (marks No. 1 through No. 5) should fall within the limits of the "bracket location" on the master gage, indicating the float switch mounting bracket is properly located. With mark "E" on the gage opposite mark "E" on the recording strip, ensure that mark "F" on the gage is below mark "F" on the recording strip, indicating the dual level control valve in the forward cell does not operate at too low a value.

t. Turn the master gage over to the No. 2 side and line up index mark No. 1 on the gage with mark No. 1 on the recording strip. Marks No. 2 through No. 5 should fall within the tolerance bands on the master gage, indicating the pump and low level warning light float switches are mounted in the proper location.

u. Remove the transfer pump operation indicator light leads and install the relay junction box cover in the right-hand radio bay; close and fasten access door.

v. Remove hose and hose adapter from forward fuel tank aft booster pump fuel drain to sight gages. (Approximately 2 gallons of fuel will drain from the pump fuel drain.)

w. Remove the fuel feed line extension hose, connect the fuel feed line to the fuel filter and close engine access door.

x. Remove the indicating sight gages from the right-hand gun bay and install access door.

y. Install nose gear downlock switch using two retaining bolts.

4-158. PRESSURE CHECKING FUEL SYSTEM.

4-159. The following pressure check of the fuel system should be performed whenever a component of the fuel system has been removed or installed (such as fuel cells, fittings and pumps) or at any time obstruction or leakage of the fuel system is suspected. Necessary equipment to accomplish the check includes the following:

a. A source of nitrogen and a means of regulating the nitrogen pressure.

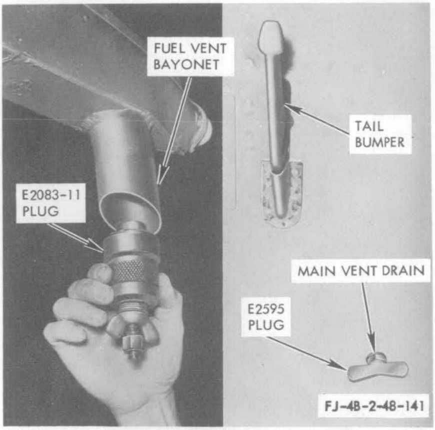


Figure No. 4-45. Main Fuel Vent Bayonet Plug and Main Fuel Vent Drain Plug

b. Suitable hoses and fittings to connect checking equipment to fuel system.

c. A 0 to 5 psi pressure gage installed downstream of the nitrogen supply.

d. Miscellaneous plugs and caps required for blocking off various lines and fittings, including an E2083-11 plug, an E2595 plug and an E2954 plug (figures 4-45 and 4-46).

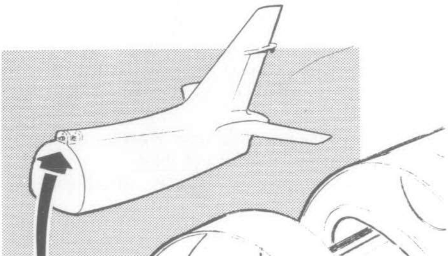


Figure No. 4-46. Aft Fuselage Fuel System Test Plug

e. A single-point refueling nozzle with a fitting to accommodate the nitrogen pressure hose (figure 4-47).

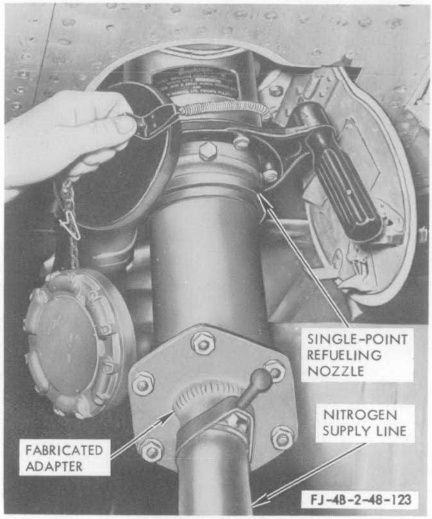


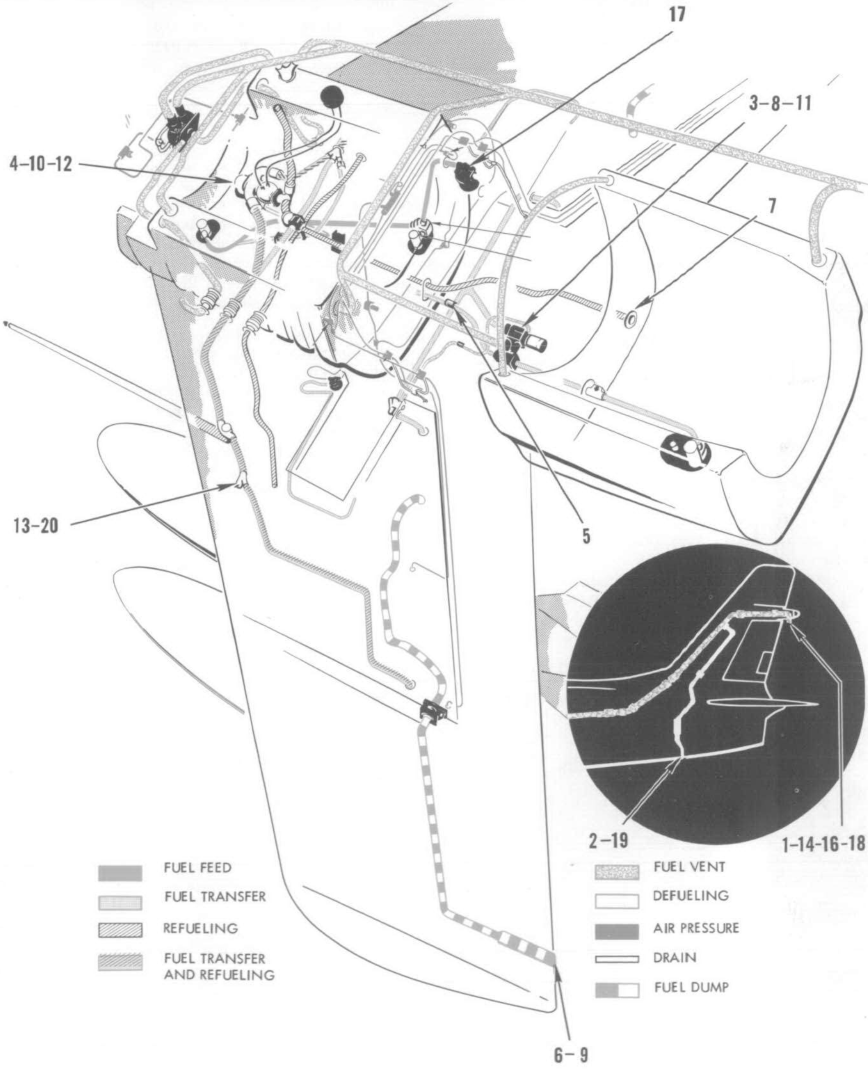
Figure No. 4-47. Single-point Refueling Adapter for Pressure Checking Fuel System

f. A Wiggins quick-disconnect nipple (Part No. 7005D24) for opening the aft cell refueling line disconnect.

The obstruction check consists of a series of steps in which the same basic operations are repeated on each line of the fuel system. Nitrogen is forced into one end of a line and a check is made to determine that it comes out the other end. On check valve tests, nitrogen is applied against the inlet side of the valve to determine a free flow through the valve in the proper direction and a check is made by applying pressure to the normally closed side of the valve to be sure that no nitrogen leaks past the valve.

Note

The use of nitrogen for pressure testing the fuel system is recommended since nitrogen is an inert gas and therefore presents no explosion hazard when introduced into a fuel cell containing fuel vapors. Dry air is not recommended, since this would increase the ratio of oxygen to fuel vapors in the cell and the possibility of an explosion would be increased.



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Figure No. 4-48. Check Points for Checking Fuel System

CAUTION

When a nitrogen bottle is used, extreme care must be employed to prevent excessive pressure entering the fuel system and damaging a fuel cell. A pressure reducer, a pressure relief valve set to relieve pressure at 4 (+0/—1) psi and a shutoff valve (upstream of the pressure relief valve) should be used.

See figure 4-48 and proceed as follows:

a. Install refueling nozzle with air hose adapter in the single-point refueling receptacle and connect nitrogen supply line (figure 4-47).

b. Connect 28-volt d-c external electrical power source to airplane.

Note

Place the d-c power switch in the "OFF" position while servicing the airplane with 28-volt external power.

c. Cap main vent bayonet (1) with E2083 plug (figure 4-45).

d. Cap main vent drain line (2) with E2595 plug (figure 4-45).

e. If auxiliary fuel tanks are installed, plug the pressure relief and vent line at the bottom of each auxiliary tank.

f. Disconnect wing tank transfer pump vent line (3) at its junction with wing tank fuel transfer pump (figure 4-49) and cap both pump vent fitting and vent line.

g. Apply 3½ psi nitrogen pressure (4) through single-point refueling receptacle.

h. Place fuel dump lever in the dump position and check for free flow at the wing dump overboard outlets on both wings.

Note

If the weight of the airplane is on the landing gear, the landing gear load relay will safety the fuel dump switch and the fuel dump operation cannot be performed unless the circuit is bridged at the load switch. This operation can be accomplished by disconnecting the arm on the safety switch at the left landing gear and actuating the arm.

i. Disconnect the Wig-O-Flex connection (5), accessible through the landing gear doors, on the aft cell fuel transfer line at its entrance to the forward cell. Restrict nitrogen flow from the wing dump line (6) by applying masking tape over the overboard outlets. Check for free flow from the aft end of the aft transfer line. Reconnect the Wig-O-Flex connector on the fuel transfer line.

Note

The landing gear doors can be opened by pulling the emergency landing gear handle approximately 13½ inches outward. This handle is located on the right side of the instrument panel.

j. Disconnect refueling line (7), accessible through engine access door at the forward bottom side of field break, and check for no nitrogen flow. Insert a quick-disconnect adapter in forward end of refueling line and check for free nitrogen flow. Remove quick-disconnect adapter and reconnect refueling line.

k. Uncap both ends of the wing tank transfer pump vent line at their junction with the wing tank fuel transfer pump.

l. Completely remove tape from wing dump overboard outlets.

m. Apply 3½ psi nitrogen pressure through single-point refueling receptacle (10) and place fuel dump selector handle in the off (full in) position. Check for free nitrogen flow from both ends of wing fuel transfer pump vent line. Reconnect transfer pump vent line (11).

Note

Airflow from the forward fuel cell end of the vent line should be slight because of flow resistance offered by a drilled flapper check valve in the pump vent line.

n. Shut off nitrogen pressure flow and remove refueling nozzle.

o. If auxiliary tanks are installed, connect nitrogen supply to auxiliary tank dive vent line (or a fabricated



Figure No. 4-49. Wing Fuel Transfer Pump Vent Line

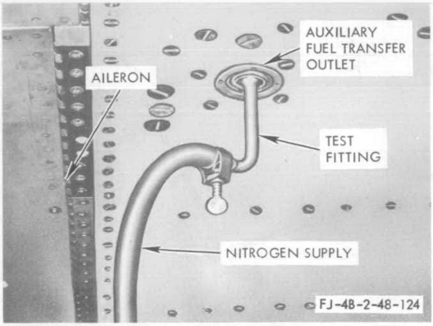


Figure No. 4-50 Auxiliary Fuel Transfer Line Test Fitting

filler cap incorporating a hose fitting for the outboard tanks). If the auxiliary tanks are not installed, remove drop tank fuel transfer line flush breakaway fitting plugs from underside of each wing (13) and connect nitrogen supply line to left-hand drop tank fuel transfer line test fitting (figure 4-50). Apply 3½ psi nitrogen pressure and uncap main vent overboard outlet (14) by removing special plug from bayonet. Check for free flow. Recap main vent outlet with special plug. Continue to apply 3½ psi pressure and allow 5 minutes for nitrogen pressure to stabilize. Close the nitrogen pressure supply line valve. Fuel system must retain 3½ psi pressure for a period of 15 minutes.

p. Transfer nitrogen supply line from left to right drop tank fuel line fitting (15). Apply 3½ psi nitrogen pressure. Uncap main vent line (16) and check for free airflow. Recap main vent line. Continue to apply 3½ psi pressure and allow 5 minutes for nitrogen pressure to stabilize. Close nitrogen pressure supply line valve. Fuel system must retain 3½ psi pressure for a period of 15 minutes.

q. Disconnect fuel supply line fitting at rear of fuel filter (17). Electrically open the fuel shutoff valve by turning ENGINE MASTER switch to the "ON" position. Air should be expelled from the engine fuel feed line at rear of filter unit. Reinstall fuel supply line to filter fitting.

r. Remove plug from main vent bayonet (18), remove cap from main vent drain line (19), remove fittings from drop tank transfer line and install plugs (20). Remove external electrical power from airplane. Remove plug from auxiliary fuel tank pressure relief and vent line openings.

Note

> The following procedures concern the checking of the aft fuselage, when removed from the airplane.

The purpose of these procedures is to ensure that the aft fuselage fuel cell, its associated lines and various check valves are functioning properly and that the fuel system will not leak when subjected to pressure. The test will be performed after the aft fuel cell installation, but before the forward and aft portion of the fuselage are mated. All points called out in the following steps are illustrated in figure 4-51.

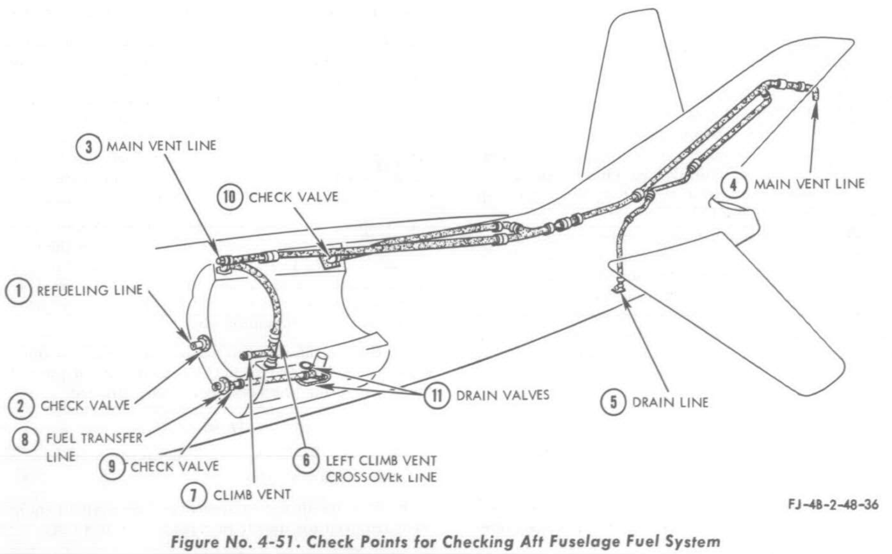


Figure No. 4-51. Check Points for Checking Aft Fuselage Fuel System

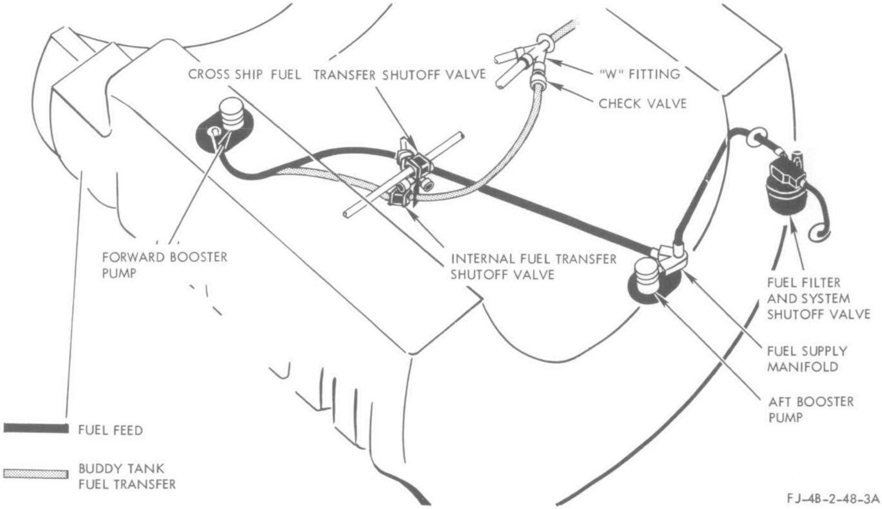


Figure No. 4-52. Fuel Feed System

s. Remove the Wiggins quick-disconnect fitting from the aft cell refueling line (1). Visually inspect the refueling line to ensure it is unobstructed. Insert a finger in the refueling line and open check valve (2) to ensure it will allow flow in the proper direction. Release the check valve and visually check to ensure it returns to its seat.

t. Connect a nitrogen source to the refueling line to the coupling (3). Cap and/or cover (step d.) all openings in the aft fuselage fuel cell except the main vent outlet (4) and the vent drain line (5).

u. Apply 3½ psi nitrogen pressure (3). Check for free nitrogen flow (4 and 5), indicating the main vent line and drain line are unobstructed. Plug the main vent outlet (4) with the pressure relief plug (step d.). Cap the main vent drain line (5).

v. Disconnect the climb vent crossover line at the left-hand side connection to the fuel cell (6). Apply 3½ psi pressure. Ensure nitrogen flows freely from both ends of the crossover line, indicating the crossover line and the aft cell dive vent line are unobstructed and the aft cell dive vent check valve allows flow in the proper direction. (On airplanes 143543l and subsequent, this check valve is removed.) Reconnect the climb vent crossover line (6).

w. Uncap the aft cell climb vent line (7). Apply 3½ psi pressure (point 1). Free nitrogen flow (7) indicates the aft cell climb vent line is unobstructed. Recap (7).

x. Attach a Wiggins quick-disconnect adapter (step f., paragraph 4-159) to the fuel transfer line (8). Apply 3½ psi pressure at (3). Check for free nitrogen flow from the fuel transfer line (8). The poppet check valve in the fuel transfer line quick-disconnect is held open by the adapter and the air should be expelled (8), indicating the line is unobstructed or the gravity fuel transfer inlet check valve (9) is operating. Remove the Wiggins quick-disconnect adapter from the fuel transfer line (8).

y. Ensure the Wiggins quick-disconnect fitting is not installed at (1). Apply 3½ psi pressure (3) and allow 5 minutes for the pressure to stabilize. Perform leakage tests. Ensure that the fuel system will maintain the initial pressure for a minimum period of 15 minutes. No leakage will indicate the refueling line check valve (2) and the poppet check valve (9) in the fuel transfer line quick-disconnect are sealing properly and there is no external leakage from the fuel cell or the vent lines.

z. Unplug the main vent drain line (5) and allow the nitrogen to drain from the vent line. After the pressure has dropped to zero, replug the vent drain line (5). The pressure should remain at zero for a period no longer than 2 minutes. This indicates the dive vent check valve (10) is sealing properly.

aa. Relieve the nitrogen pressure in the cell by opening the two drain valves (11) in the bottom of the cell, thereby ensuring these valves are unobstructed.

Note

If no nitrogen is expelled from the drain valves, the test is not valid.

ab. Remove all test equipment and reinstall all equipment removed for the aft fuselage fuel system tests.

4-160. FUEL FEED SYSTEM.

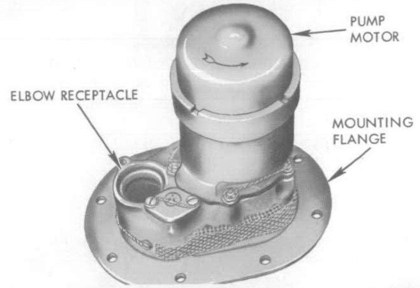
4-161. The fuel feed system (figure 4-52) consists of two booster pumps, a fuel feed manifold, a fuel filter and a shutoff valve, with the necessary fuel lines to carry the fuel from the forward fuselage cell to the engine. A separate fuel line branches off the fuel feed line, slightly aft of the forward booster pump, and connects to the right-hand drop tank interconnector fitting ("W" fitting) for transfer of internal fuel to the buddy tanker. This buddy tanker transfer line incorporates a motor-operated shutoff valve and a check valve.

4-162. FUNCTION OF FUEL FEED SYSTEM.

4-163. When the ENGINE MASTER switch is positioned to "MASTER," the aft fuel booster pump is energized (figure 4-54), supplying fuel through the fuel feed manifold (which incorporates three check valves, one in each pump line to prevent reverse flow in the event one pump should not operate, and one to provide a suction feed should both booster pumps fail), through the fuel filter and shutoff valve and to the engine-driven fuel pump. At any time the airplane's landing gear is not down, the forward booster pump also will operate.

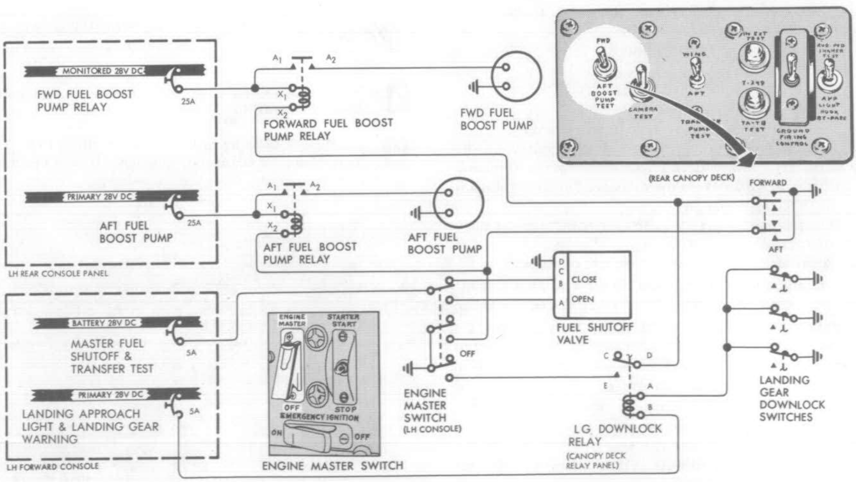
4-164. FUEL BOOSTER PUMPS.

4-165. Two submerged-type booster pumps (figure 4-53) are installed in the forward fuselage fuel cell, one forward and one aft. The aft booster pump operates continuously when the ENGINE MASTER switch is in the "MASTER" position, providing the d-c power switch is in any position other than "OFF" or when 28-volt external power is provided (figure 4-54). The forward booster pump operates only when the ENGINE MASTER switch is in the "MASTER" position and the landing gear switch-down relay is energized (landing gear in the up position). This prevents cavitation in the fuel feed line during landings (when low on fuel). The centrifugal-type booster pumps maintain 17 to 23 psi pressure at the booster pump outlet. Two single-pole, double-throw, momentary-type toggle switches, located aft of the pilot's seat on the right side of the canopy deck, are used to ground test the pumps.



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Figure No. 4-53. Fuel Booster Pump



FJ-4B-2-48-143

Figure No. 4-54. Fuel Feed System—Electrical Schematic

WARNING

- Under no conditions operate a tank-mounted fuel boost pump when there is insufficient fuel in the tank to completely submerge the pump seal.
- Never perform maintenance on a booster pump while it is in operation.
- Never apply electric power to an airplane which has open fuel cells.

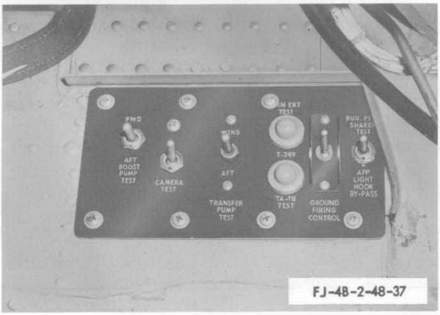


Figure No. 4-55. Fuel Booster and Fuel Transfer Pump Test Panel

4-166. CHECKING FUEL BOOSTER PUMPS. To check the fuel booster pumps, located in the forward fuselage fuel cell, for operation, proceed as follows:

CAUTION

Be sure sufficient fuel is in fuel cell to completely submerge pump.

a. Position ENGINE MASTER switch to "MASTER."

b. Position BOOST PUMP TEST switch (located on the right-hand aft canopy deck) to "FWD." Have someone feel outside of forward pump to assure forward pump is operating. Release switch.

c. Position BOOST PUMP TEST switch to "AFT." Check pump by feel. Release switch.

d. Position ENGINE MASTER switch to "OFF."

4-167. CHECKING FUEL BOOSTER OR TRANSFER PUMPS FOR SEAL LEAKAGE. Leakage from the pump seal drain may indicate a worn or defective pump, or a pump seal that is "lifting off" because of dirt or foreign matter under the seal. If fuel leakage past the pump seal is 8 drops per minute or greater, the pump can be considered defective and must be replaced. If leakage is less than 8 drops per minute, attempt to dislodge dirt or foreign matter and seat the seal by operating pump for approximately one minute. After allowing sufficient time for previous leakage to dissipate, examine pump for seal leakage. If excessive leakage persists, replace pump.

4-168. REMOVING AND INSTALLING FUEL BOOSTER PUMPS.

REMOVING

Warning Be sure ENGINE MASTER switch is in the "OFF" position and external power source is disconnected from airplane.

1 Drain fuel system. (Refer to paragraph 1-35.)

2 Remove pump access cover.

3 Disconnect two electrical leads at pump.

4 Remove bolt securing fuel outlet fitting to pump base.

5 Remove bolts securing pump to cell mounting flange and remove pump. (Also, remove support clips if removing aft cell transfer pump.)

6 Protect mounting flange opening with suitable cover.

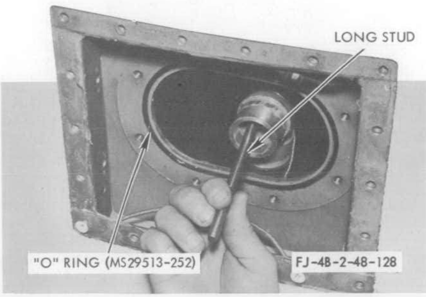
INSTALLING

1 Make sure d-c power switch is "OFF" and external source of electrical power is disconnected from airplane.

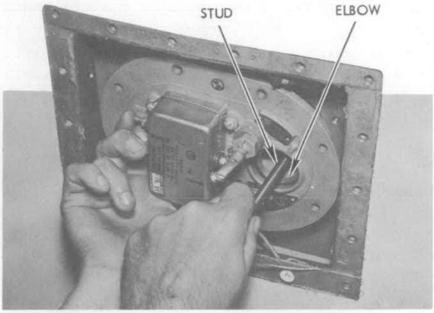
Warning Failure to comply with step 1 may result in an explosion.

2 Remove protective cover and attach long stud (bolt-head sawed off) to booster pump elbow.

3 Lubricate "O" ring with petrolatum (item 100, materials list) and install in groove at tank mounting flange.

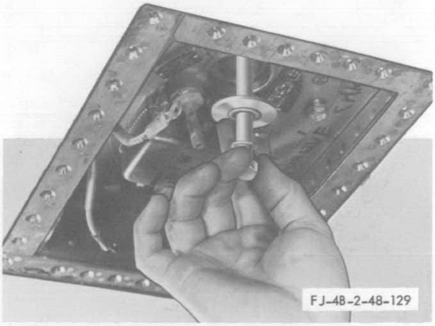


4 Insert booster pump into cell, and seat elbow in its receptacle by pulling on long stud. Install flange mounting bolts. Torque to 35 (±5) inch-pounds.

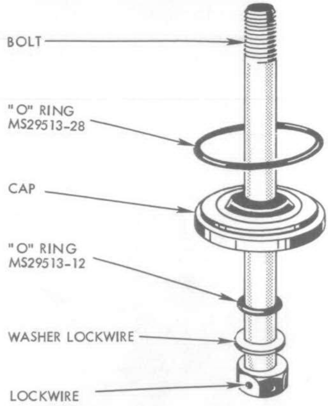


5 Remove stud and install bolt with washer, "O" rings, and cap in proper place. Torque bolt to 115 (±10) inch-pounds and safety with AN995F32 lockwire.

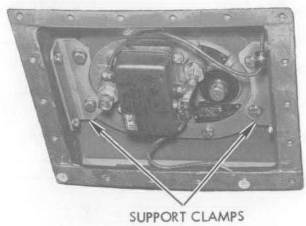
Note If Thompson Products Inc or Lear-Romec booster or transfer pumps are to be installed in place of the Pesco Products pump, the MS29513-29 "O" ring and cap are not used.



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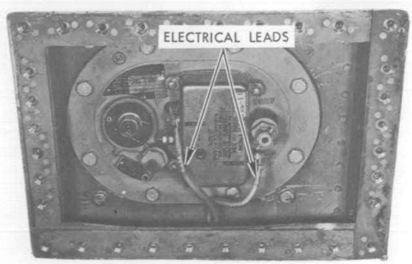


Note On aft fuel cell transfer pump installation only, install two support clamps.



6 Connect electrical leads.

7 Install access cover.



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4-169. FUEL SYSTEM SHUTOFF VALVE.

4-170. The electrically operated fuel system shutoff valve (figure 4-56) is located in the forward right-hand side of the engine compartment and is incorporated in the top of the fuel filter. The valve is a motor-operated, gate-type valve and incorporates a small thermal relief valve to supply thermal pressure relief for the filter. A Cannon-type receptacle is provided on top of the valve for the electrical connection.

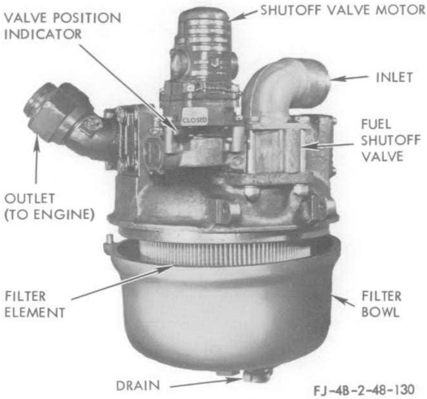


Figure No. 4-56. Fuel System Filter and Shutoff Valve

4-171. CHECKING FUEL SYSTEM SHUTOFF VALVE. To check the fuel system shutoff valve, open the right-hand engine access door and check indicator arm on the aft outboard side of valve (figure 4-56). After making sure the valve is in the "closed" position, proceed as follows:

a. Disconnect Cannon plug from top of valve.

b. Position ENGINE MASTER switch to the "ON" position.

c. Disconnect engine supply line from aft end of fuel filter and check to see that fuel is not leaking past valve.

d. Reconnect supply line to aft end of fuel filter.

e. Position ENGINE MASTER switch to the "OFF" position.

f. Reconnect Cannon plug to receptacle on top of fuel shutoff valve.

g. Close right-hand engine access door. No check is necessary for the "open" position of this valve unless the engine will not start. In this case, check the indicator arm on the aft outboard side of the fuel shutoff valve.

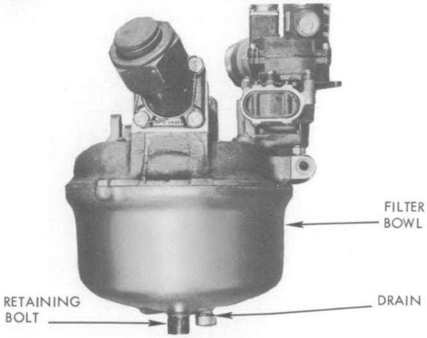
4-172. FUEL SYSTEM FILTER.

4-173. The fuel filter (figure 4-56), located on the right-hand side of the forward engine compartment, is a Purolator-type filter, housing a 40-micron removable element and a relief valve set to open at approximately 5 psi. The relief valve by-passes the fuel if the filter element becomes obstructed. A push-type drain is installed on the bottom of the filter bowl with provisions for draining condensation. The fuel system shutoff valve is installed on top of this unit.

4-174. REMOVING, CLEANING AND INSTALLING FUEL SYSTEM FILTER.

Warning Be sure engine master switch is "OFF" and external electrical power is disconnected from airplane.

1 Remove access door in top of right wheel well.



2 Open drain at bottom of filter and drain unit.

3 Remove bolt from bottom center of filter bowl; then remove bowl.

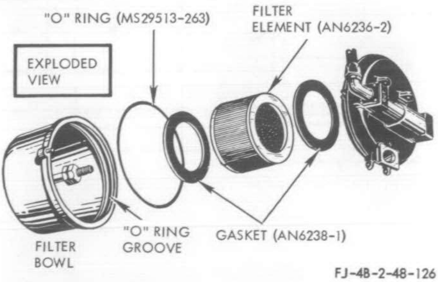
4 Remove filter element from bowl.

5 Discard filter element if a new element is available. In an emergency the old element may be cleaned for further service.

6 Using a soft-haired brush, wash all parts except "O" rings and gaskets with dry cleaning solvent (item 119, materials list). Dip soft-haired brush in solvent and wash filter head; then dry with lint-free cloth.

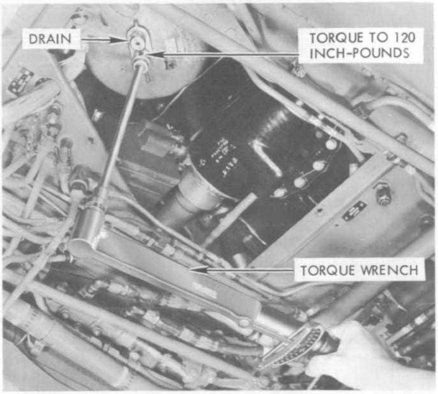
Caution Do not use a wire brush on any part of the filter.

7 Place filter element in filter bowl.



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8 Install new "O" ring in groove around filter bowl.

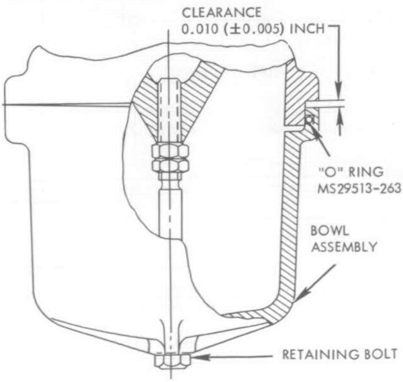


9 Secure filter bowl to filter head by torquing retaining bolt at the bottom center of bowl to 120 inch-pounds; then safety bolt with AN995F32 safety wire.

Caution Do not torque fuel filter bowl retaining nut to more than 120 inch-pounds or filter bowl may crack.

10 Close drain at bottom of filter bowl.

11 With the bowl and head in contact at any point, the clearance at a point 180 degrees opposite shall be 0.010 (±0.005) inch.



12 Install access door in top of right-hand wheel well.

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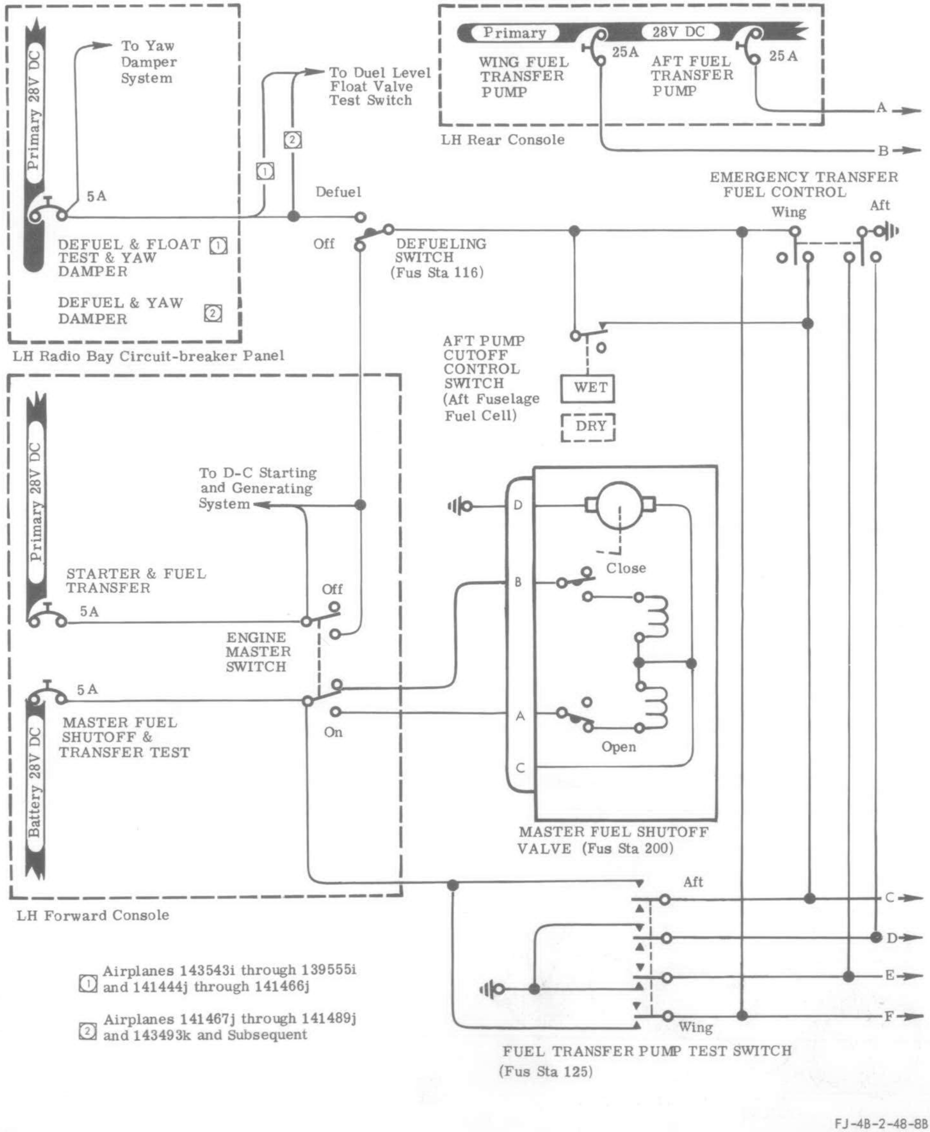


Figure No. 4-57. Fuel Transfer System—Electrical Schematic (Sheet 1)

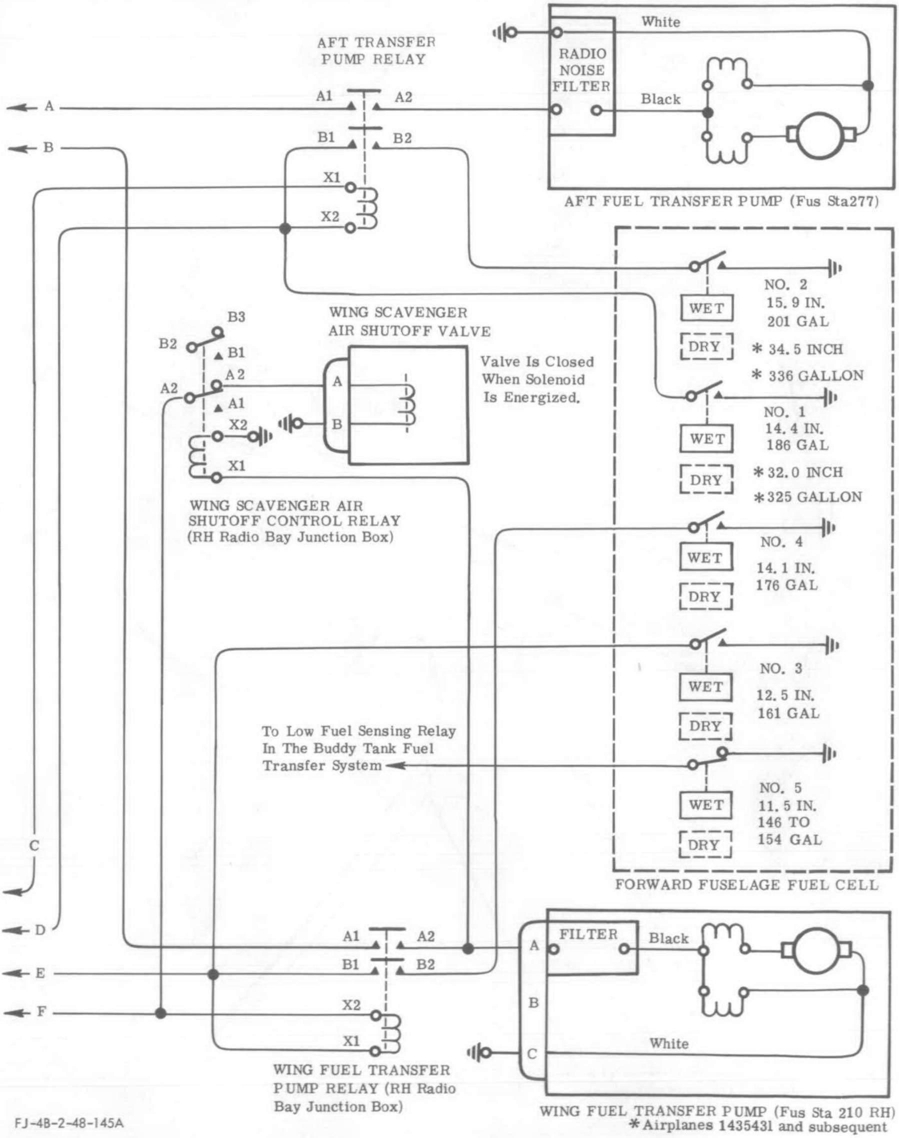


Figure No. 4-57. Fuel Transfer System—Electrical Schematic (Sheet 2)

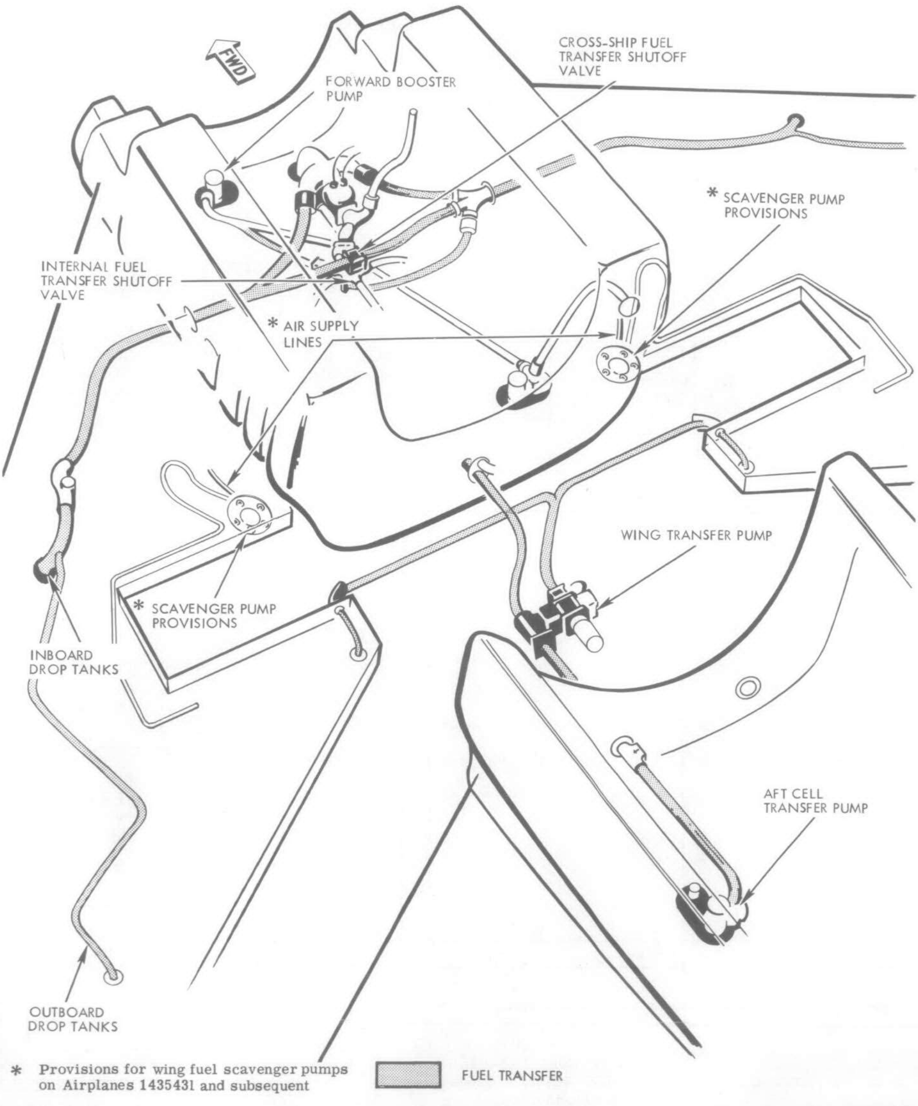


Figure No. 4-58. Fuel Transfer System

4-175. FUEL TRANSFER SYSTEM.

4-176. The fuel transfer system (figure 4-58) consists of a float switch assembly in the forward fuselage cell, an aft cell fuel transfer pump, a wing tank fuel transfer pump and the necessary relays, wiring and lines. The system is controlled primarily by the engine master switch. Fuel from the aft cell is transferred by a submerged transfer pump through a line to the forward fuselage cell. Gravity transfer is accomplished by fuel flow through the transfer line; fuel enters through either the transfer pump or a check valve located at the forward face of the cell. All but 25 gallons of fuel is available for gravity transfer in level flight at sea level. The aft cell fuel transfer line is provided with a quick-disconnect at the field break which automatically prevents loss of aft fuselage cell fuel when the aft fuselage section is removed. A check valve in the aft transfer line prevents reverse flow. During aft transfer pump operation, fuel is pumped to the forward cell at the rate of approximately 9500 pounds per hour at sea level. The pump is controlled by the fuel level float switches. (For sequencing of these float switches, refer to steps o. and p., paragraph 4-157.) The integral wing tanks are interconnected by a line which is also connected to the line-mounted wing fuel transfer pump. The outlet line of the pump connects with the transfer line from the aft fuselage cell. Check valves, located at the outlet of each wing tank and at the inlet to the forward fuselage cell, prevent reverse flow. A check valve passageway within the wing fuel transfer pump assembly allows gravity flow to by-pass the pump in the event of pump failure. The buddy tanker utilizes the drop tank transfer lines to transfer fuel from the buddy tanks to the airplane's internal fuel system. The 150-gallon outboard auxiliary tank and the 200-gallon auxiliary tank also utilize the drop tank transfer lines for transfer of fuel and refueling. On airplanes 1435431 and subsequent, provisions for two wing fuel scavenge pumps are provided, one in each wing, to transfer trapped fuel from an area forward of the landing gear housing to an area aft of the landing gear housing for pickup by the wing fuel transfer pump supply line.

4-177. WING FUEL TRANSFER PUMP.

4-178. The wing fuel transfer pump (figure 4-59) is line-mounted (located above the forward end of the engine access door) and forms the junction of the aft and wing tank transfer lines. The pump, a centrifugal type, is motor-driven and incorporates a seal drain and a system drain outlet. The maximum amperage for normal pump operation is 17 amperes. The pump motor is of the single-speed type and operates on 27 volts dc. The disconnect plug incorporates a radio noise filter.

4-179. CHECKING WING FUEL TRANSFER PUMP. To check the wing fuel transfer pump, located above the forward end of the engine access door, for operation, proceed as follows:

a. Position ENGINE MASTER switch to "MASTER."

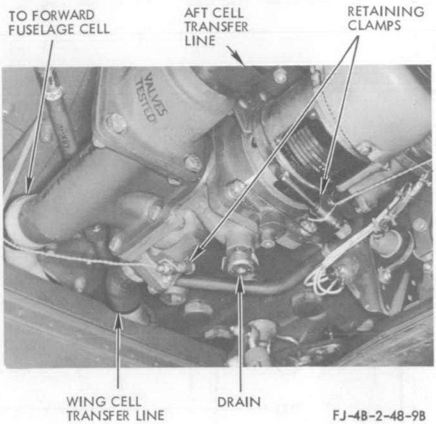


Figure No. 4-59. Wing Fuel Transfer Pump

b. Position TRANSFER PUMP TEST switch (located on the right-hand aft canopy deck) to "WING." Check pump for operation by having someone feel the pump. Release switch.

c. Position ENGINE MASTER switch to "OFF."

4-180. CHECKING WING FUEL TRANSFER PUMP FOR SEAL LEAKAGE. Refer to paragraph 4-167.

4-181. REMOVING WING FUEL TRANSFER PUMP. To remove wing fuel transfer pump (figure 4-59), remove the engine access door on bottom of airplane, just forward of the field break, and proceed as follows:

WARNING

Be sure ENGINE MASTER switch is in the "OFF" position and external electrical power source is disconnected from airplane.

a. Disconnect aft tank transfer line.

b. Disconnect forward fuselage tank transfer line.

c. Disconnect wing tank transfer line.

d. Disconnect pump vent line.

e. Disconnect Cannon plug at pump.

f. Remove clamp from transfer pump and from transfer pump manifold.

g. Lift out pump and manifold assembly.

h. Remove fuel transfer pump manifold.

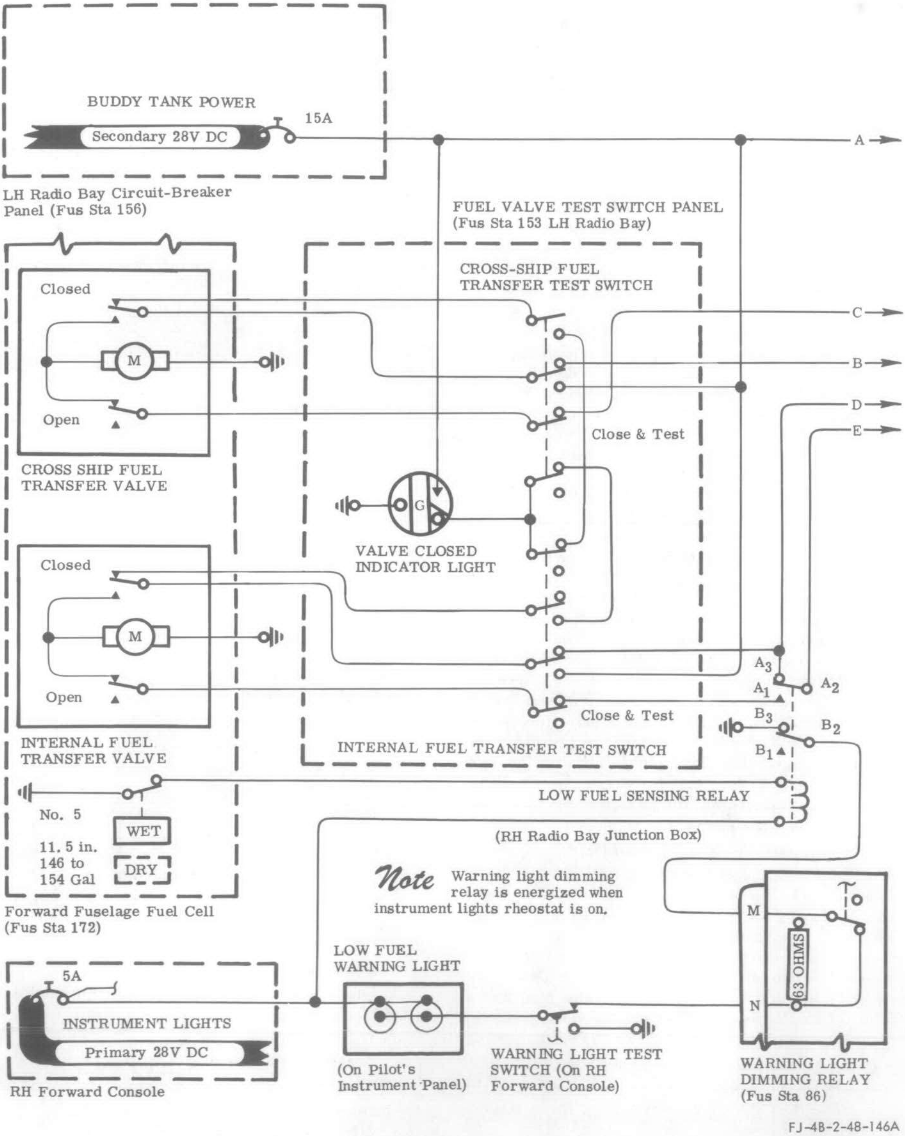
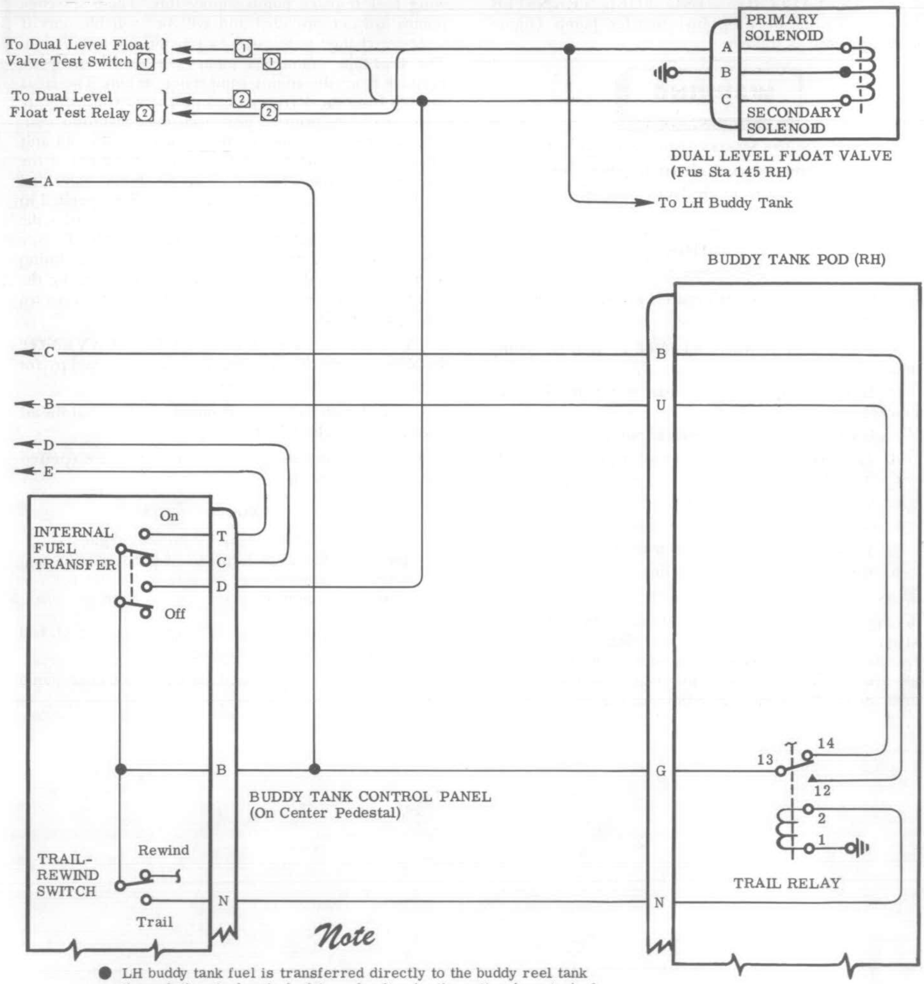


Figure No. 4-60. Buddy Tank Fuel Transfer System—Electrical Schematic (Sheet 1)



Note

- LH buddy tank fuel is transferred directly to the buddy reel tank through the airplane's fuel transfer line by the action (opening) of the cross-ship fuel transfer valve when the TRAIL - REWIND switch is in the "TRAIL POSITION."
- Airplane internal fuel is transferred to the buddy reel tank by positioning the INTERNAL FUEL TRANSFER switch to the "ON" position.
- Fuel can be transferred from the buddy tanks to the main fuselage cell by air pressure as shown in the auxiliary fuel system.

1 Airplanes 139531i through 139555i and 141444j through 141466j

2 Airplanes 141467j through 141489j and 143493k and subsequent

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Figure No. 4-60. Buddy Tank Fuel Transfer System—Electrical Schematic (Sheet 2)

4-182. INSTALLING WING FUEL TRANSFER PUMP. To install wing fuel transfer pump (figure 4-59), proceed as follows:

WARNING

Be sure ENGINE MASTER switch is in the "OFF" position and external electrical power source is disconnected from airplane.

CAUTION

Be sure "O" rings are installed properly on the above manifolds.

a. Install fuel transfer manifold to transfer pump manifold.

b. Install clamp around transfer pump manifold to bracket.

c. Install clamp around transfer pump to bracket.

d. Connect Cannon plug to transfer pump and safety with AN995F32 lockwire.

e. Connect pump vent line.

f. Connect wing tank transfer line.

g. Connect forward fuselage tank transfer line.

h. Connect aft tank transfer line.

4-183. WING FUEL SCAVENGE PUMPS.

4-184. On airplanes 139531i through 143542k, provisions are incorporated for two wing fuel scavenge pumps, one in each wing, to transfer trapped fuel from an area forward of the landing gear housing to an area aft of the landing gear housing for pickup by the wing fuel transfer pump supply line. These scavenge pumps are not provided and will be available only if a service change is released to provide the installation. The vane-type submerged pumps are air-driven by air pressure from the engine compressor section. The air is derived from the defrost and anti-ice supply duct slightly forward of the primary heat exchanger manifold unit. The air pressure is then routed through a manifold unit (located on the aft side of the forward bulkhead of the engine compartment), through an air shutoff valve and to the scavenge pumps. A control valve, incorporated in the pump, senses fuel outlet pressure and throttles the airflow to the pump turbine. The control valve is wide open, allowing air pressure to operate the turbine, closing at 45 psig. The air solenoid valve is controlled by the wing fuel transfer pump float switch in the forward fuselage fuel cell.

4-185. CHECKING WING FUEL SCAVENGE PUMPS. To check the wing fuel scavenge pumps for operation, proceed as follows:

a. Disconnect the scavenge pump supply line at the air pressure manifold (figure 4-69).

b. Connect an external source of air pressure (preferably nitrogen pressure).

Note

Be sure to incorporate an air pressure regulator (set from 9 to 15 psi) and an air pressure relief valve (set to relieve at 50 psi) in the air (or nitrogen) supply line.

c. With the pressure supply (step b.) connected, feel the pumps for a definite vibration.

d. Remove air supply and reconnect scavenge pump air supply line.

4-186. (Deleted.)

4-187. AFT CELL FUEL TRANSFER PUMP.

4-188. The aft cell fuel transfer pump, located in the bottom of the aft fuel cell in the aft fuselage section, is identical to the fuel booster pump (paragraph 4-164) except for the mounting provisions (paragraph 4-168).

4-189. CHECKING AFT CELL FUEL TRANSFER PUMP. To check the aft cell fuel transfer pump for operation, remove the pump access door on the bottom of the aft fuselage and proceed as follows:

a. Position ENGINE MASTER switch to "MASTER."

b. Position TRANSFER PUMP TEST switch (located on the right-hand aft canopy deck) to "AFT." Check pump for operation by having someone feel the pump. Release switch.

c. Position ENGINE MASTER switch to "OFF."

4-190. CHECKING AFT CELL FUEL TRANSFER PUMP FOR SEAL LEAKAGE. Refer to paragraph 4-167.

4-191. REMOVING AND INSTALLING AFT CELL FUEL TRANSFER PUMP. Refer to paragraph 4-168.

4-191A. INTERNAL FUEL TRANSFER AND CROSS SHIP FUEL TRANSFER SHUTOFF VALVE SWITCHES.

4-191B. Two test switches, located in the left-hand radio bay, are provided to indicate the position (open or closed) of the internal fuel transfer and cross ship fuel transfer shutoff valves. The test switches are incorporated on a small panel which provides an indicator light to determine if the valves are closed. The indicator light will illuminate if either valve is closed when the appropriate switch is positioned to "CLOSE & TEST." If the valves are not closed, positioning the INTERNAL FUEL TRANS or the CROSS SHIP FUEL TRANS test switch to "CLOSE & TEST" will close the valve. These valves must be closed for normal operation of the fuel system. If the internal fuel transfer valve is left open, the aircraft is limited to level and unaccelerated flight. If the cross ship fuel transfer valve is left open, a laterally unbalanced condition can result during flight (with drop tanks installed) causing excessive fuel to be trapped in one of the drop tanks.

WARNING

The INTERNAL FUEL TRANS and the CROSS SHIP FUEL TRANS test switches must be actuated to "CLOSE & TEST" after the buddy tanks or buddy tank control panel have been installed or removed and after any electrical work has been accomplished on any portion of the fuel system. (Refer to paragraph 4-196.)

4-192. INTERNAL FUEL TRANSFER SHUTOFF VALVE.

4-193. The internal fuel transfer shutoff valve, located in the forward fuselage fuel cell cross, is provided to transfer internal fuel to the buddy reel tank (when installed). This valve is normally controlled from the buddy tanker control panel in the cockpit. When the buddy tanker control panel and tanks are not installed, this motor-operated shutoff valve must be checked to determine that it is in the closed position.

WARNING

If this valve is left in the open position, fuel transfer from the internal fuel system to the drop tanks could result, preventing use of this portion of fuel. This creates a hazardous condition by having a full drop tank during certain flight conditions. With the airplane in a nose-down flight attitude, the aft booster pump could be starved of fuel and the fuel from the forward booster pump being transferred to the auxiliary tanks could cause insufficient fuel to the engine; thus a flame-out could occur. Check this valve in accordance with the instructions in paragraph 4-196.

4-194. CROSS SHIP FUEL TRANSFER SHUTOFF VALVE.

4-195. The cross ship fuel transfer shutoff valve, located in the forward fuselage fuel cell cross, is provided for transfer of buddy tank fuel from the left-hand (fuel) tank to the right-hand (reel) tank. This motor-operated valve is normally controlled from the buddy tanker control panel, when installed, and should be checked to ensure that it is closed when the panel is not installed. If the valve is in the open position without the buddy tanks being installed, fuel could transfer from one drop tank to another and improper fuel transfer would result. Check the cross ship fuel transfer valve in accordance with the instructions in paragraph 4-196.

4-196. CHECKING INTERNAL FUEL TRANSFER AND CROSS SHIP FUEL TRANSFER SHUTOFF VALVES. To check the internal fuel transfer and cross ship fuel transfer shutoff valves for being in the closed position, see figure 4-61 and proceed as follows:

a. Position the D.C. POWER switch to "BAT. & GEN."

b. Open left-hand radio bay access door and position the INTERNAL FUEL TRANS switch to "CLOSE & TEST."

c. Continue to hold switch to "CLOSE & TEST" until the valve closed light illuminates. (This will prove that the valve is closed.)

d. Release switch.

e. Position CROSS SHIP FUEL TRANS switch to "CLOSE & TEST."

f. Repeat steps c. and d.

g. Close left-hand radio bay access door.

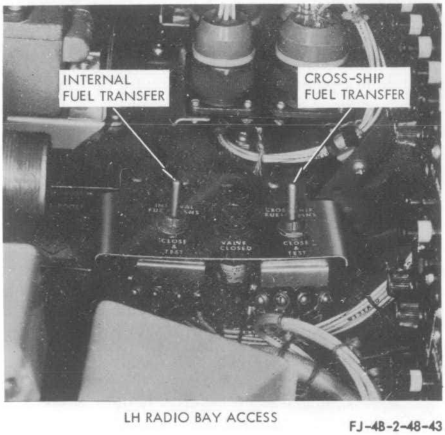


Figure No. 4-61. Test Panel for Fuel Transfer System Shutoff Valves

4-197. FUEL TRANSFER SYSTEM FUEL LEVEL LIMIT SWITCHES.

4-198. On airplanes 139531i through 143542k, the fuel level limit switches (paragraph 4-230), mounted on the right-hand side of the forward fuselage cell baffle assembly, are of the float-type design. There are five switches mounted at approximately the same location but varying in the height level at which they are mounted.

Note

- The F21065-2X fuel transfer float switches (on airplanes 139531i through 143542k) are interchangeable physically but are not interchangeable magnetically. The magnet of one float may have the opposite polarity of the magnet in another float. When several switches are installed in close proximity, all of the magnets must have the same polarity. If they do not, the strength of the magnet, in relation to its respective set of points, may be reduced to the point where the switch contacts would fail to operate under all conditions.
- It is recommended that, when replacing the F21065-2X float switch, the polarity of all of the switches in the group be checked, as well as the replacement switch. (The polarity may be checked using a magnetic compass.)

On airplanes 143543l and subsequent, two switches are mounted on hangers below the fuel level float valve and three switches are mounted on the right-hand side of the anti-slosh baffle. Two of these switches control the sequencing of the aft transfer pump and two switches control the sequencing of the wing transfer pump by energizing the wing transfer or aft transfer pump relays when the fuel level of the forward cell falls below the level of the limit switches. The fifth (and lowest mounted) fuel level limit switch controls the illumination of the low level fuel warning light and the closing of the internal fuel transfer shutoff valve which prevents the transfer of a predetermined amount of fuel from the airplane's fuel system to the buddy tanks.

4-199. LOW FUEL WARNING LIGHT. The fuel transfer system low fuel warning light is located on the right-hand lower side of the instrument panel. It is a double bulb-type light with a plastic cover. (Refer to paragraph 6-41.)

4-200. AFT FUEL TRANSFER PUMP SHUTOFF SWITCH. A float switch (paragraph 4-231), located in the aft fuselage fuel cell adjacent to the aft transfer pump, is provided to shut off the aft transfer pump when the cell is empty. This switch protects the pump against running dry. The absence of fuel as a cooling and lubricating medium would cause overheating of the pump bearings and brushes and eventually could cause complete pump failure.

4-201. EMERGENCY FUEL TRANSFER SYSTEM.

4-202. The emergency fuel transfer system (figure 4-57) consists of a control panel, located on the left-hand console assembly, which incorporates a three-position switch ("WING TANKS," "AUTOMATIC" and "AFT TANK"). This switch, when positioned, will directly energize the transfer pump relays and override the normal sequencing of the limit switches in the transfer system.

4-203. FUEL VENT SYSTEM.

4-204. The fuel system is vented to allow air to enter the cells during a dive to prevent negative pressures and to relieve positive pressures during a climb (figure 4-62). The two U-shaped fuselage cells are vented for climb at both top forward corners. A dive vent is provided by a connection at the rear and near the top of each fuselage cell. Dive venting of the wing tanks is accomplished through the same lines which are used for climb venting. This is provided by a line from the left and right wing cells to the fuel vent manifold. Both climb and dive vent lines are connected to the main vent line which is routed through the fuselage on the top right-hand side from the forward fuselage cell to the dorsal fin and up the vertical stabilizer where it terminates at an outlet near the top of the trailing edge. The vent outlet is scarfed slightly to maintain a slight positive pressure on the fuel cells. No expansion space is provided in the fuel cells. However, any increase in fuel level due to thermal expansion will cause fuel to flow into the vent lines when the tanks are full. The vent lines have a total capacity of about 9 gallons. Expansion in excess of this amount will cause fuel to be routed out a drain line, connected just below the main vent outlet in the top of the vertical stabilizer, and to flow overboard on the bottom of the aft rear fuselage section.

4-205. FUEL VENT BAYONET. The fuel vent bayonet (figure 4-45) always should be treated with utmost care. Never use the bayonet for a support or handhold when handling the aft fuselage. The bayonet, located near the

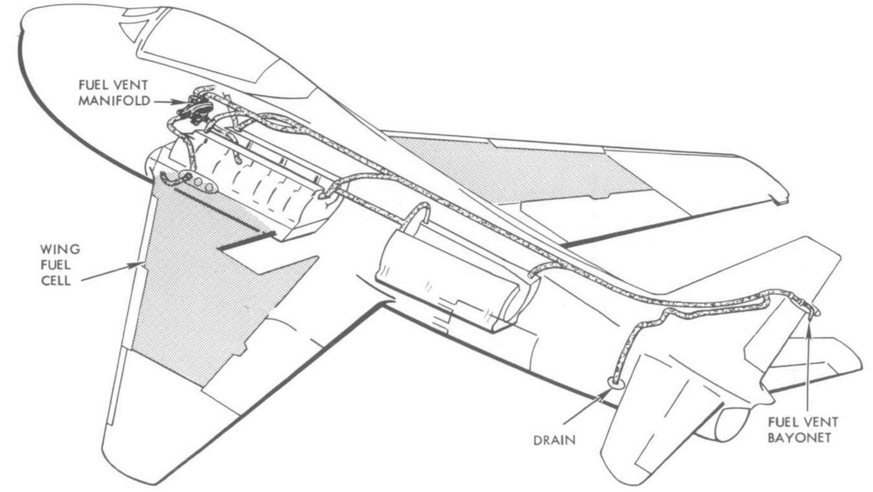


Figure No. 4-62. Fuel Vent System

top of the vertical stabilizer on the trailing edge, should never be handled, unless it is being replaced, since a damaged or broken condition could result.

CAUTION

Always replace the fuel vent bayonet; never repair it.

Changing the scarf angle by attempting to repair the bayonet could alter the slight positive pressure the bayonet was designed to retain. This could result in a partial collapse of the fuel cells when the airplane descends rapidly from high altitude, thus causing an erroneous indication on the fuel level gage. Also, when the fuel cells are overpressurized, a puncture of the cell could result which could cause leakage of fuel.

4-206. FUEL DUMP SYSTEM.

4-207. The fuel dump system (figure 4-63) consists of a control handle, located on the forward left-hand vertical console, a combination wing tank fuel vent shutoff valve and an air pressure shutoff valve, two wing fuel dump shutoff valves, two flapper valves and numerous cables, pulleys and lines. Each wing has a dump line running outboard from the wing sump area through a manually operated shutoff valve, through a wing fold flapper valve mechanism and out to the trailing edge of the wing near the tip where fuel is vented overboard. Fuel is dumped overboard through this line by pressurizing the wing cells with air pressure furnished from the air conditioning and pressurization system. Pressure is regulated by the use of two flow-limiting orifices and a pressure relief valve which is regulated at 9 to 12 psi. Pulling the fuel dump handle (figure 4-64) moves a cable which closes the wing tank fuel vent shutoff valve, located on top of the fuel vent manifold, and the air shutoff portion of this valve is actuated to the open position. The cable also actuates the fuel dump shutoff valves located just inboard of the field break on each wing.

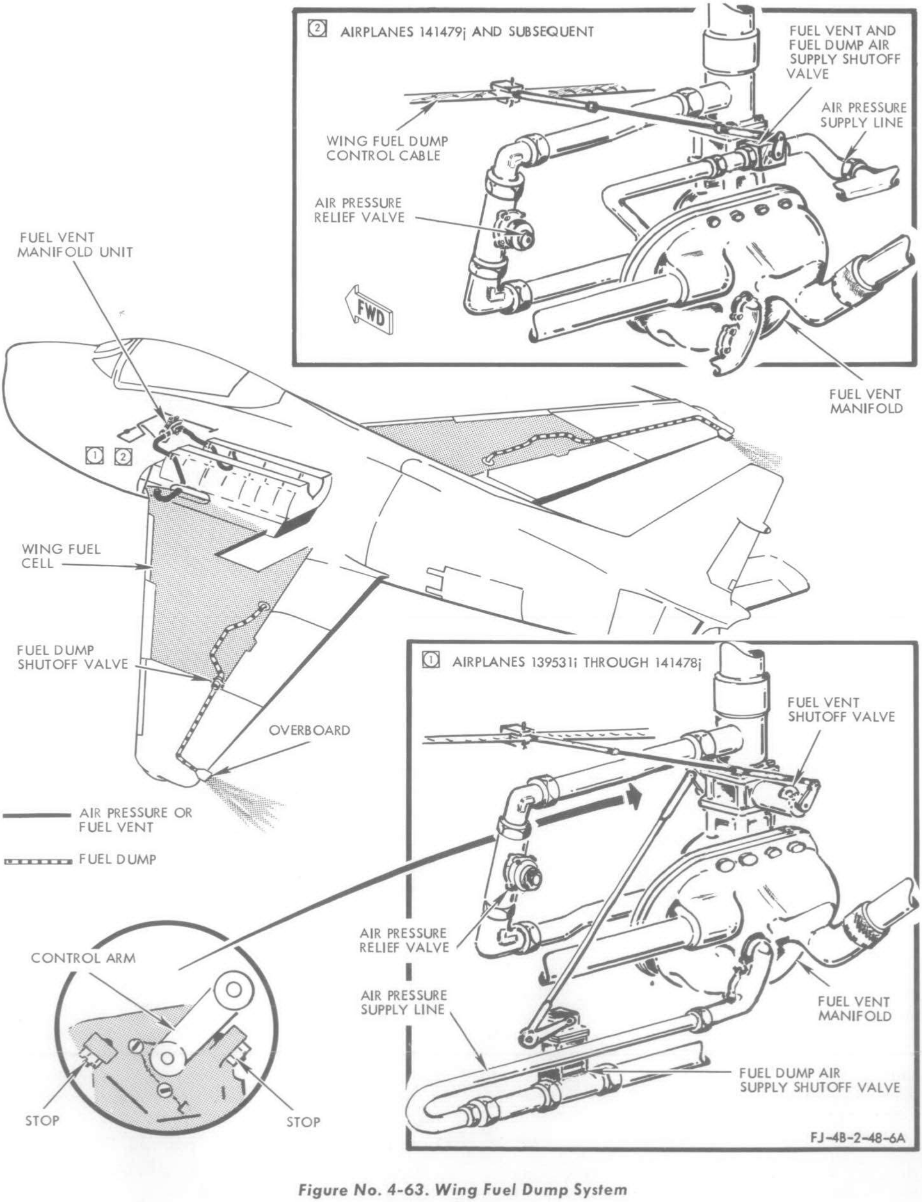


Figure No. 4-63. Wing Fuel Dump System

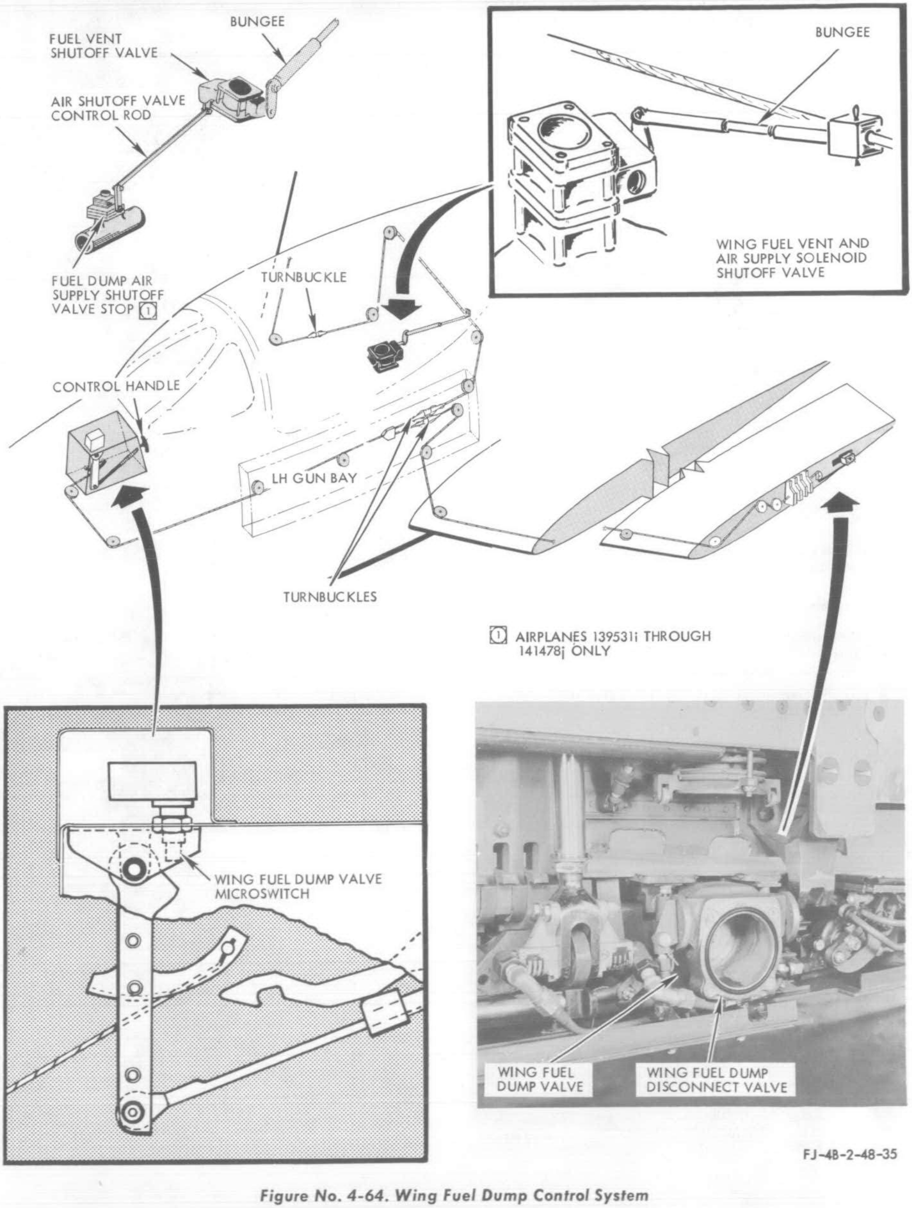
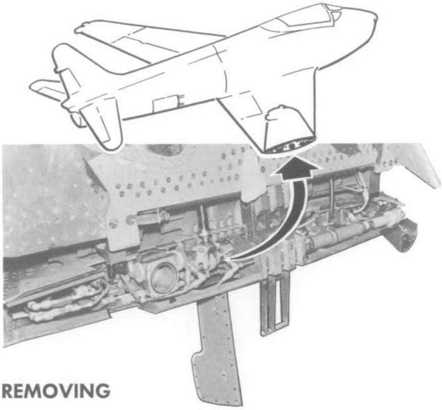


Figure No. 4-64. Wing Fuel Dump Control System

4-208. REMOVING, INSTALLING AND ADJUSTING WING FUEL DUMP VALVE ASSEMBLY.

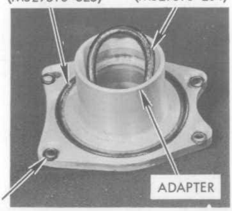


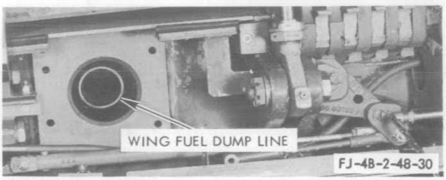
REMOVING

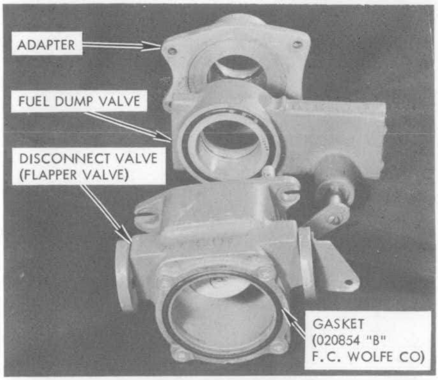
1. Remove support rod from forward side of flapper valve to lower wing fairing bracket.
2. Disconnect fuel dump valve arm from control rod.
3. Remove bolts from wing fuel dump disconnect valve.
4. Lift out disconnect valve, shutoff valve and adapter.

INSTALLING

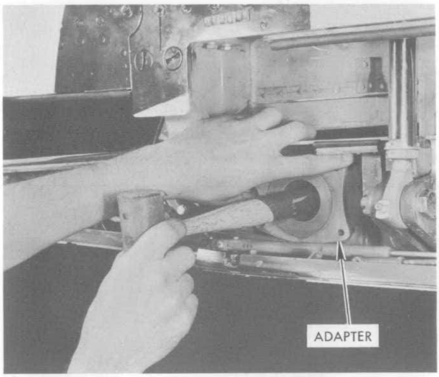
1. Before installing adapter, make sure "O" ring is installed in the rear of each bolt hole, in the inside tapered end of the adapter and on the back side of the flange. (See figure 4-7.)



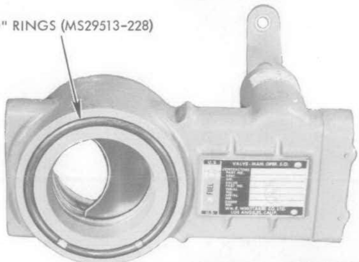




2. Position adapter in place using mallet handle or similar device to center fuel dump line in adapter.

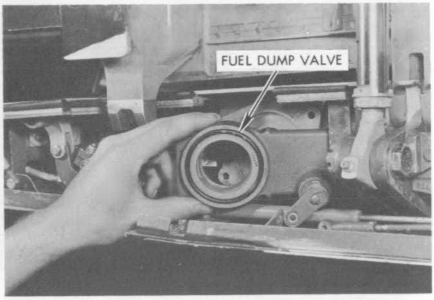


3. Be sure "O" ring is installed on each side of fuel dump valve.

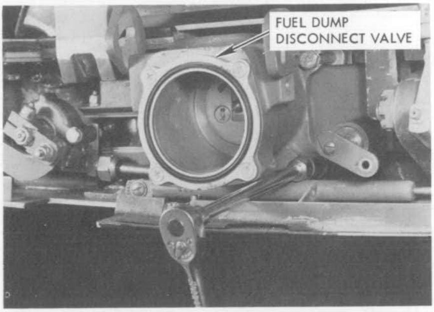


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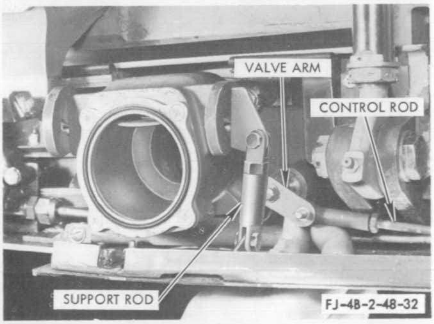
4 Position fuel dump valve in place.



5 Position wing fuel dump disconnect valve in place and install retaining bolts through flapper valve and adapter flange and be sure the small "O" rings in back of the adapter flange holes are in place.



6 Connect fuel dump valve arm to control rod by installing screw head to the back side so as to clear bungee when operated.

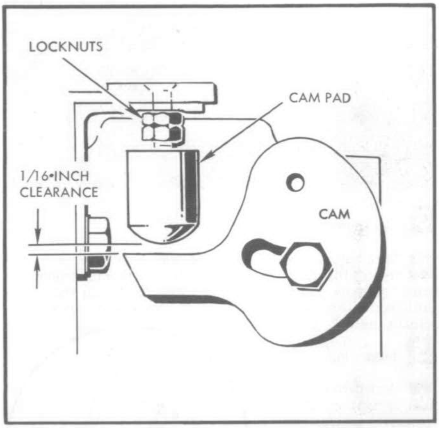


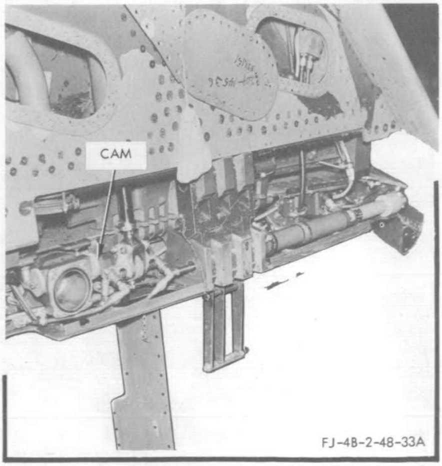
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7 Install support rod from forward side of flapper valve to lower wing fairing bracket.

8 With cam retaining bolts loose, install two cam pads and two adjustment screws incorporating two locknuts on each screw.

9 Adjust screw until 1/16-inch clearance is obtained between cam pad and cam. Tighten locknuts.



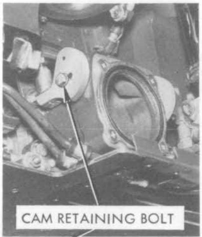
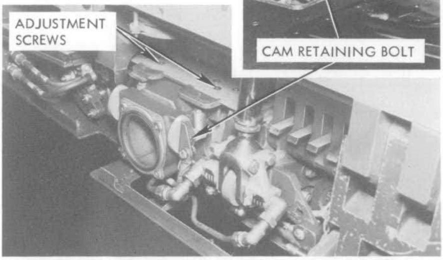


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ADJUSTING

1 Loosen cam retaining bolts.

2 Turn adjustment screws counterclockwise to their maximum travel.

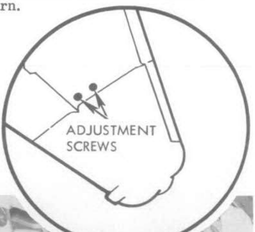



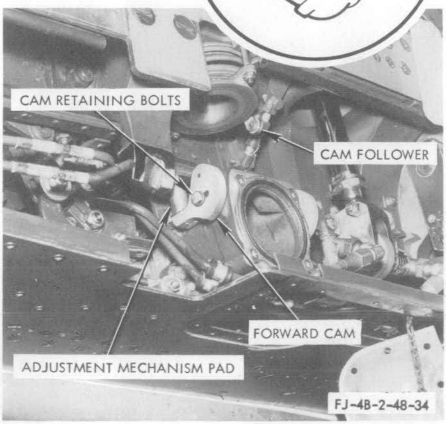
3 Spread wing.

4 Turn adjustment screws clockwise until cam is free of follower (indicated by lack of tension when turning screw); turn counterclockwise until cam and follower make contact and back off adjustment screw clockwise 1/2 to 3/4 turn.

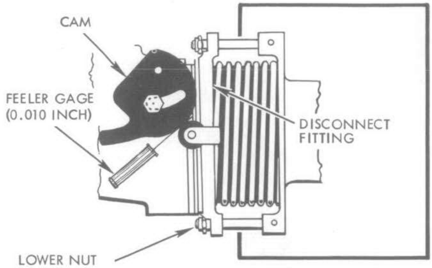
5 Fold wing.

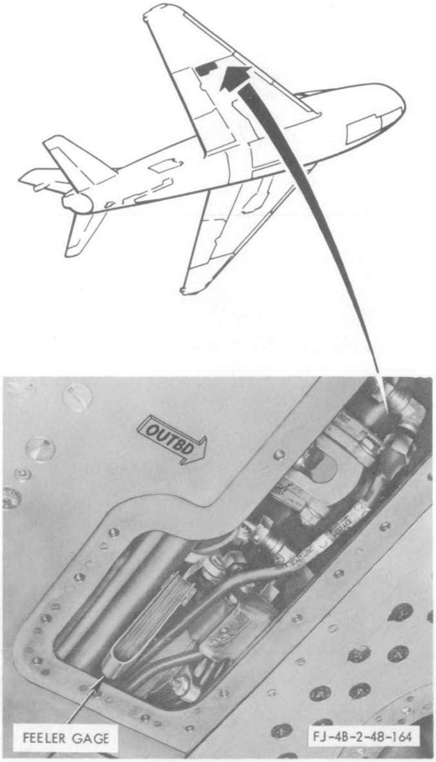
6 Seat cam firmly against adjustment mechanism pad and tighten cam retaining bolts.



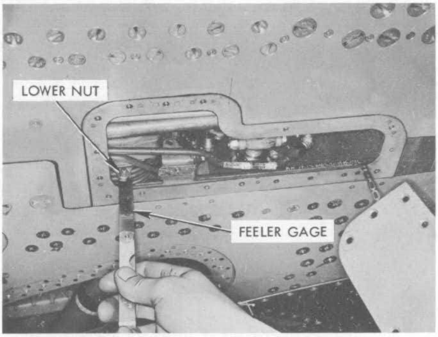


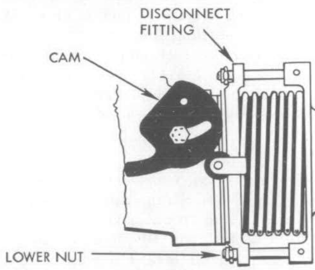
7 Spread wing and check forward cam for 0.005- to 0.010-inch clearance.



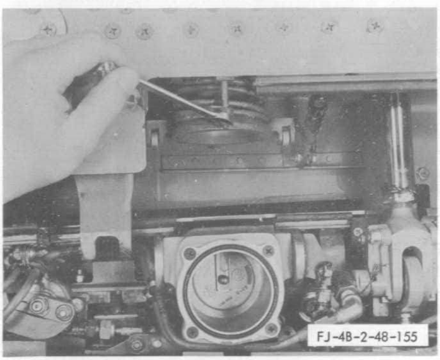


8 Adjust lower nut on disconnect fitting allowing 1/16 inch between the nut and fitting surface (use feeler gage).





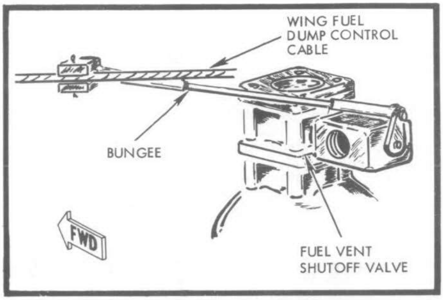
9 Fold wing and adjust upper nut to match lower nut. (This can be determined by amount of exposed threads.)



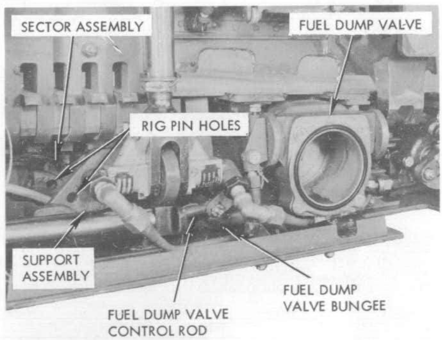
4-209. RIGGING AND ADJUSTING WING FUEL DUMP CONTROL SYSTEM.

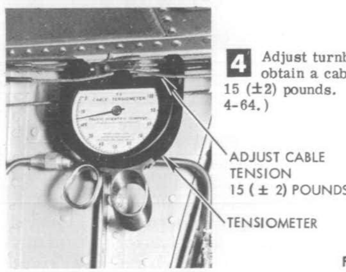
1 Put wing fuel dump control handle in full forward position. (See figure 4-64.)

2 Remove bungee.



3 Install 5/16-inch diameter pin through support and sector assemblies in both wings.





4 Adjust turnbuckles to obtain a cable tension of 15 (±2) pounds. (See figure 4-64.)

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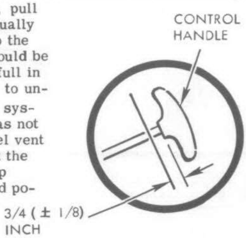
5 Connect bungee to cable and adjust free length of bungee so that bolts may be freely inserted in fuel vent shutoff valve lever with lever against the stop in normal position. Bolts are to be finger-tight to one-half thread loose.

6 Adjust fuel dump valve control rod until fuel dump valve is in closed position.

7 Adjust air shutoff valve control rod assembly to position arm of fuel dump air supply shutoff valve against stop (airplanes 139531i through 141478j only). (See figure 4-64.)

8 Install fuel dump valve bungee. Adjust load of bungee so that cable tension is not relaxed when rig pin is removed. Remove rig pin.

9 Cycle the system several times. Return wing fuel dump control handle to full forward position and make certain the fuel dump valve has returned to full closed position. To cycle system, pull handle full out and manually reposition the handle to the forward stop. This should be 3/4 (±1/8) inch aft of full in position. (Push handle to unlock cable.) Re-check system to be sure cable has not relaxed and that the fuel vent shutoff valve is against the stop when the fuel dump valves are in the closed position.



10 Maximum control handle load not to exceed 85 inch-pounds.



11 Maximum load to release control handle is not to exceed 40 pounds.

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4-210. SINGLE-POINT REFUELING SYSTEM.

4-211. The single-point refueling system (figure 4-36) is provided to expedite ground refueling operations. The system consists of a refueling receptacle and test switch, located on the bottom side of the fuselage, slightly aft of the nose wheel door and accessible through a flush door on the fuselage skin, a dual level control valve, a dual level float valve (a level control valve in each tank if 200-gallon auxiliary tanks or buddy tanks are installed), a flow limiter valve, a standpipe, check valves and necessary lines (including some of the normal fuel system lines) to carry the fuel to the cells and/or drop tanks. (On airplanes 143543l and subsequent, a level control valve is incorporated in the aft fuselage cell. This provides for complete refueling of the aft cell without the fuel being controlled by the dual level control valve in the forward cell.)

Note

The OUTBOARD DROP TANKS REFUEL switch must be placed in the "REFUEL" position to furnish power to the aft fuel cell shutoff valve and level control switches during single-point refueling. Fuel overboards from the aft fuel cell through the vent lines if the refuel switch is not on.

If 150-gallon drop tanks are installed on airplanes 141467j and subsequent, the OUTBD DROP TKS switch (in the refueling receptacle well) must be placed in the "REFUEL" position. Provisions also are included for checking operation of the dual level control valve during refueling (paragraph 4-216). A flow limiter valve is incorporated in the refueling line between the dual level control valve and the fuel supply manifold on airplanes 139531i through 143542k. The flow limiter valve prevents the refueling of the fuel system at excessive rates which could damage the aft fuel cell. (See figure 4-37.)

Note

The following data is based upon carrier design fuel pressures. The system can withstand fuel pressure sources having 70 psi maximum pressure at 0 to 170 gpm and 50 psi maximum pressure at flows greater than 170 gpm.

FILLING RATE	FILLING TIME
WITH NO AUXILIARY TANKS	
168 gpm	5 minutes (840 gallons)
WITH TWO 200-GALLON AUXILIARY TANKS	
163 gpm	7.6 minutes (1240 gallons)
WITH TWO 200-GALLON AND TWO 150-GALLON AUXILIARY TANKS	
179 gpm	8.6 minutes (1540 gallons)
WITH IN-FLIGHT REFUELING TANKER (BUDDY TANKS) PACKAGE	
185 gpm	7.6 minutes (1408 gallons)

4-212. FUNCTION OF SINGLE-POINT REFUELING SYSTEM.

4-213. To accomplish single-point pressure refueling, it is necessary to insert the refueling nozzle into the refueling receptacle and lock in position by turning to the right. The fuel nozzle is opened by actuation of a lever; a cam-operated plunger in the nozzle simultaneously extends to open the spring-loaded valve in the receptacle. Fuel enters the system through the dual level control valve and flows to the drop tanks (inboard, outboard or buddy tanks), wing tanks and aft fuselage cell. The wing tanks and aft cells, in turn, feed the forward fuselage cell through the transfer and fuel vent lines. When the forward fuselage cell is at full capacity, the dual level float

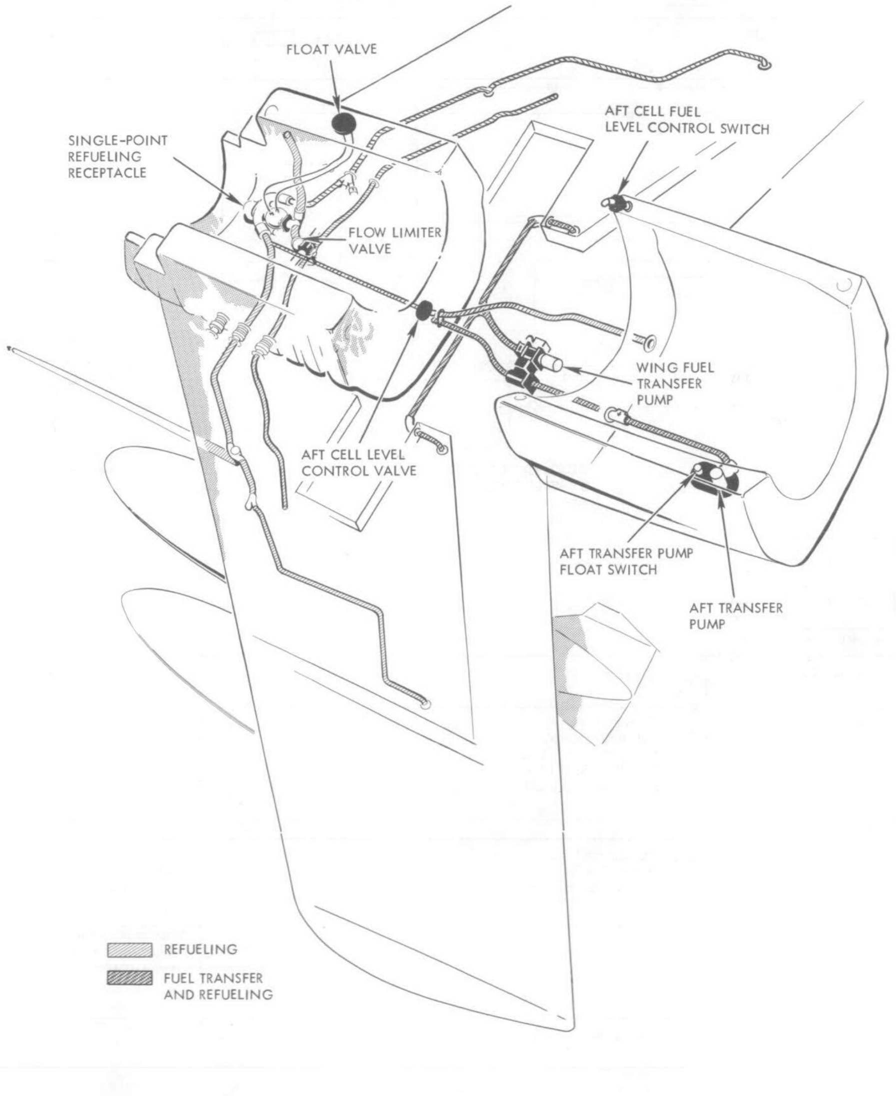


Figure No. 4-64A. Single-point Refueling System— Airplanes 143543I and Subsequent

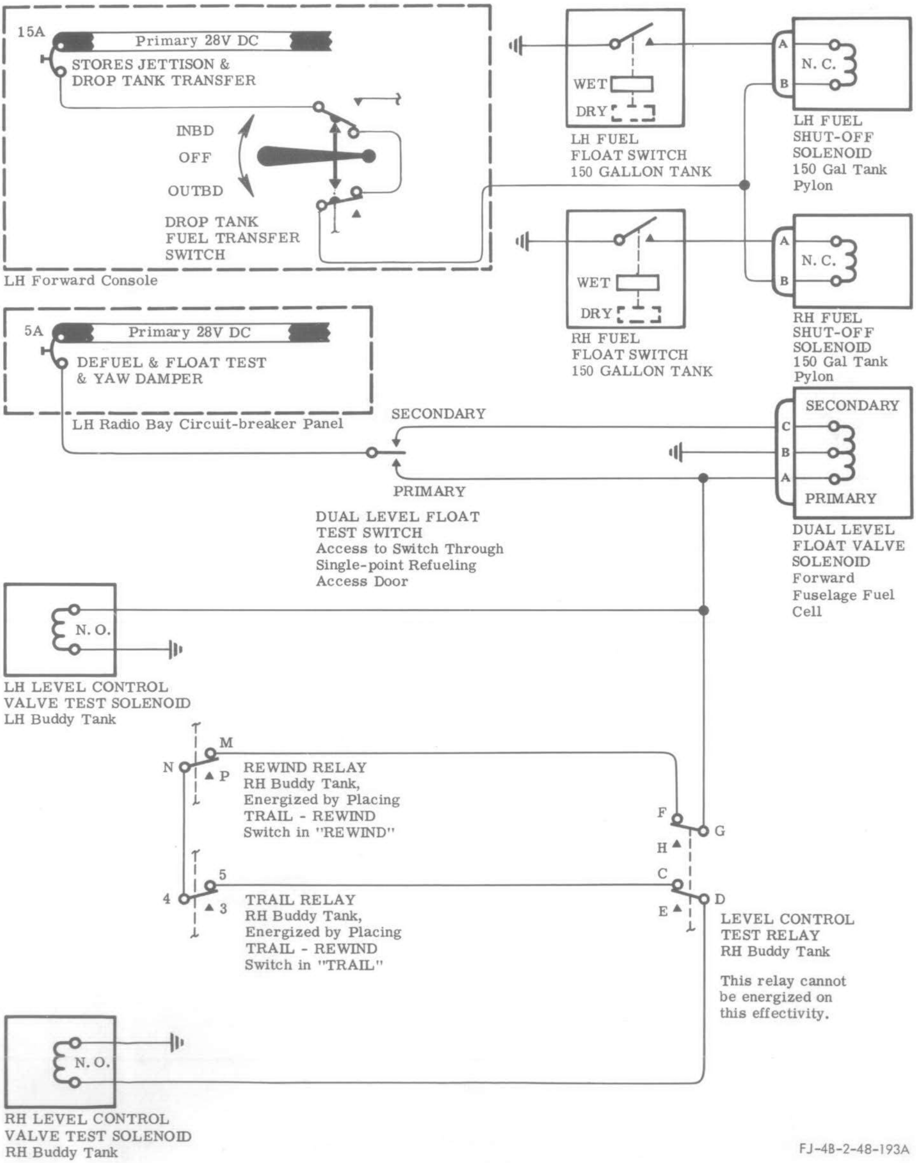


*Figure No. 4-64B. Refueling System—Electrical Schematic—
Airplanes 139531i through 141466j*

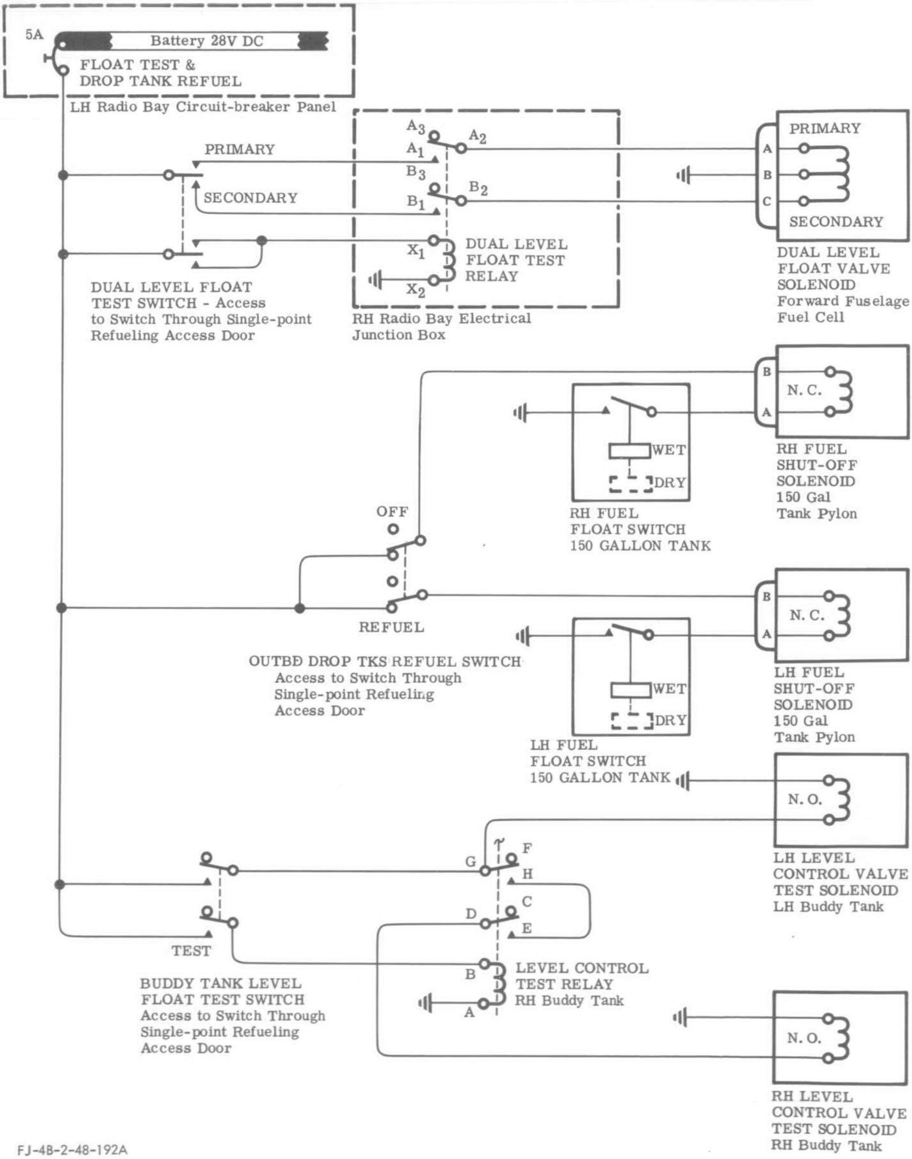


Figure No. 4-64C. Refueling System—Electrical Schematic—Airplanes 141467j through 143542k

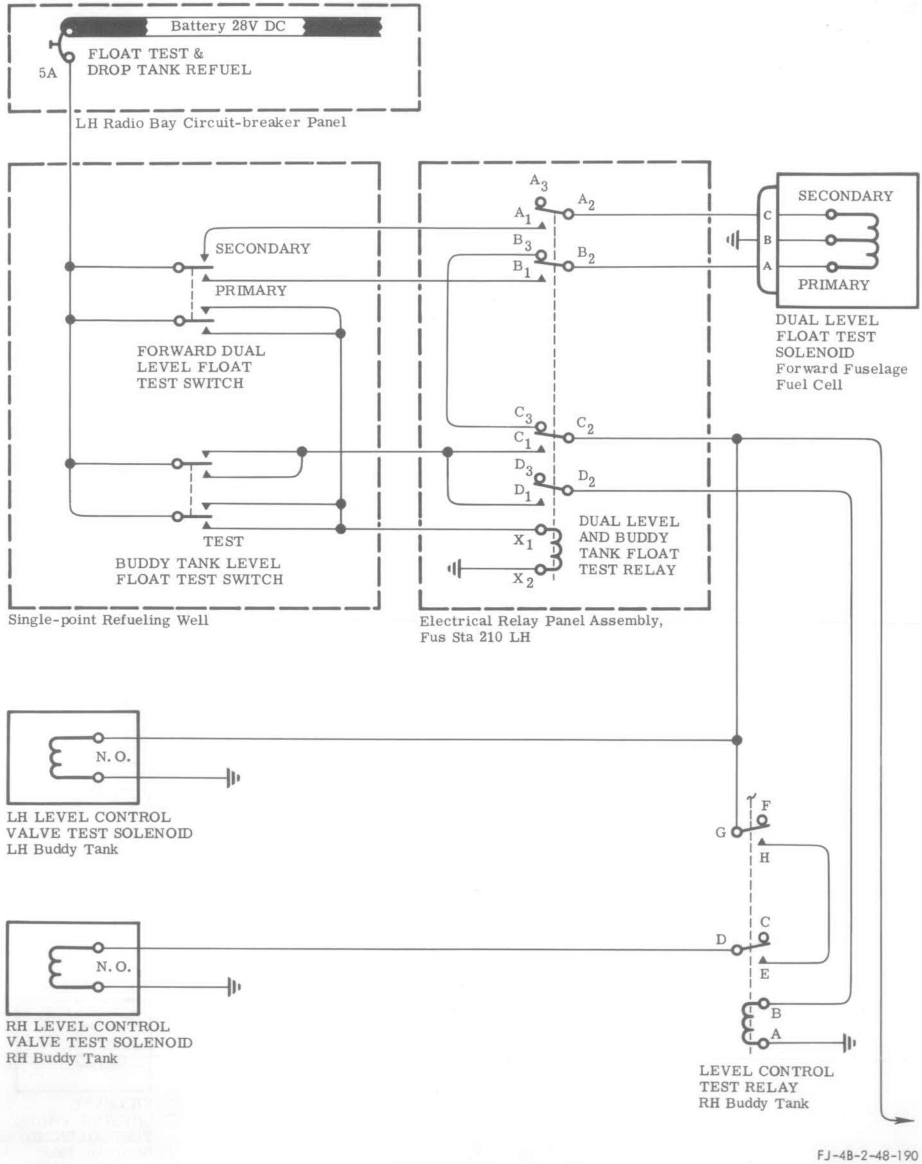
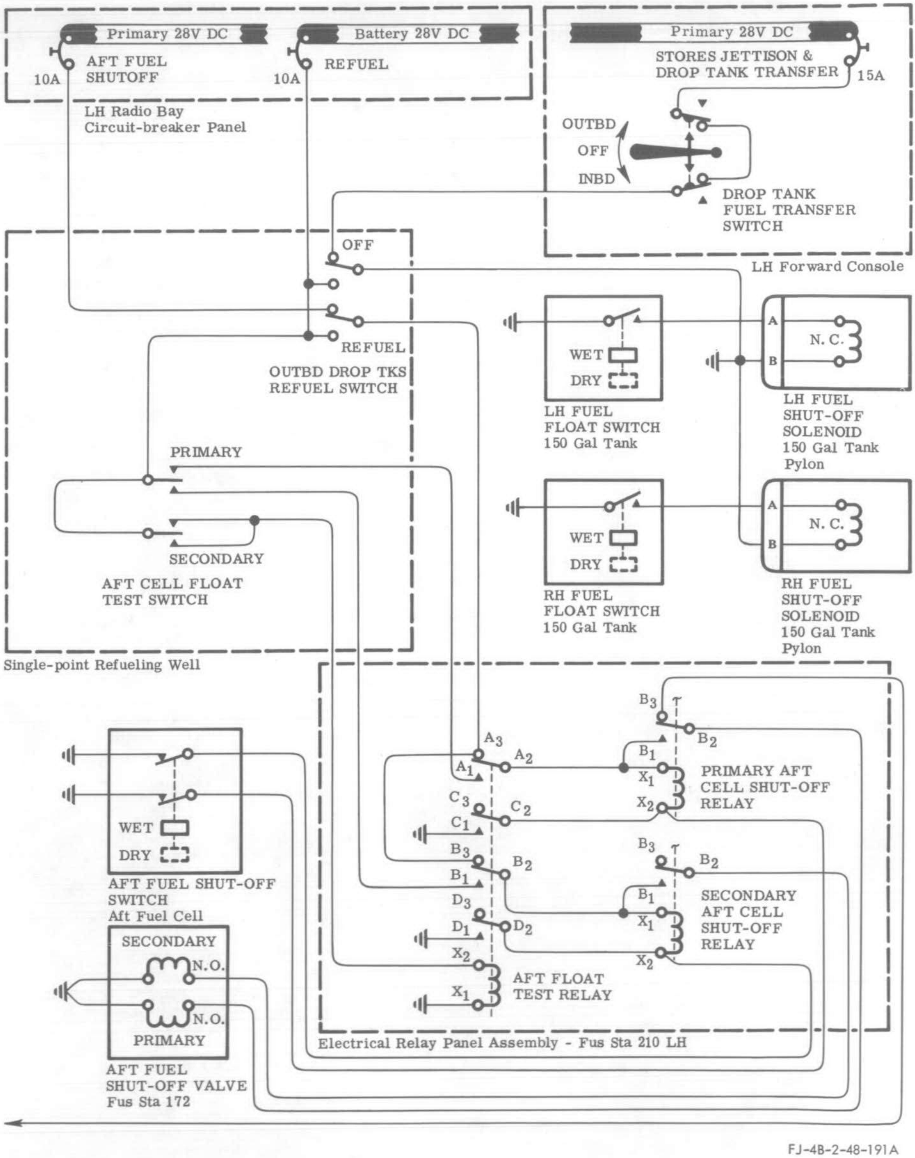
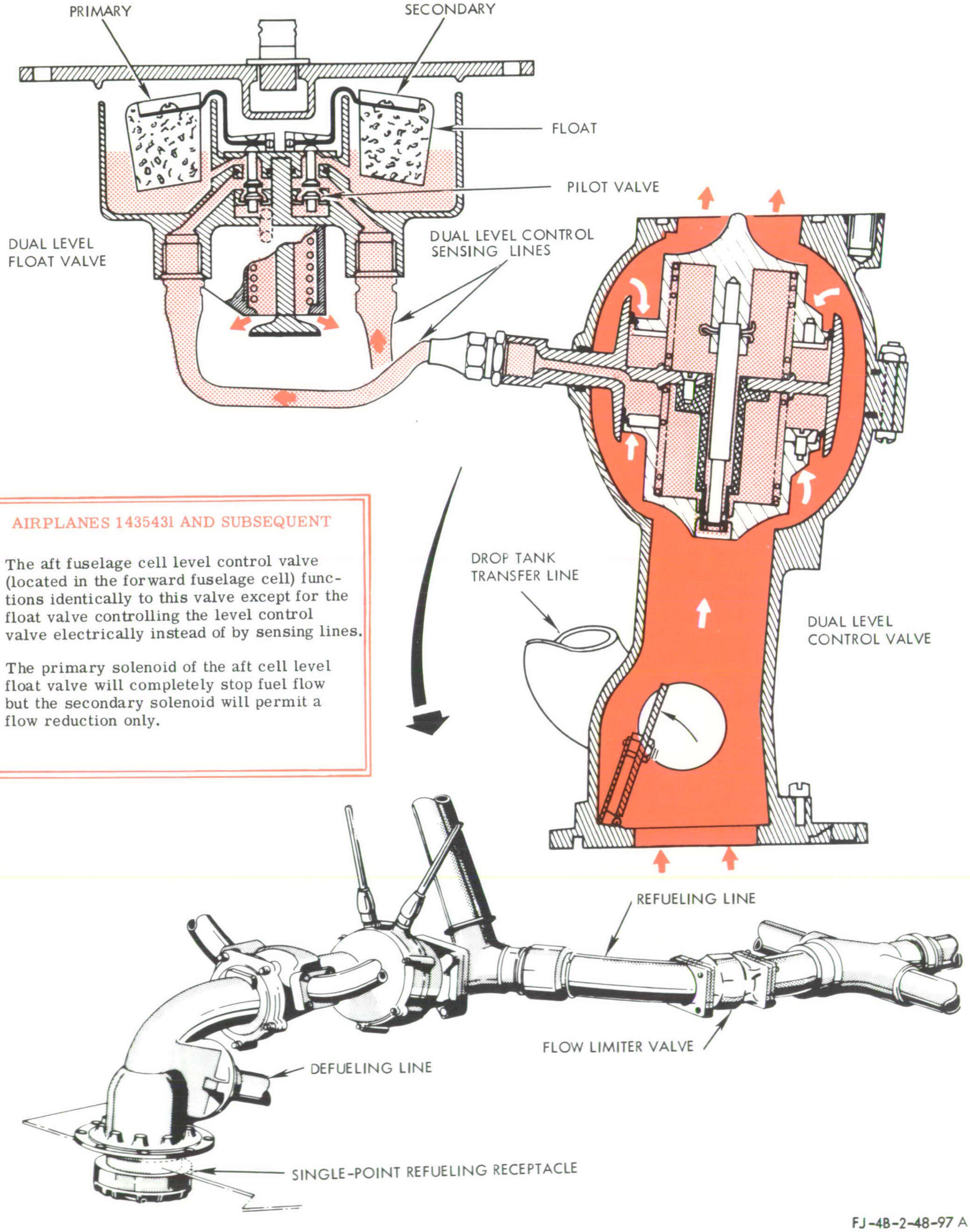


Figure No. 4-64D. Refueling System—Electrical Schematic—Airplanes 143543I and Subsequent (Sheet 1)



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Figure No. 4-64D. Refueling System—Electrical Schematic—Airplanes 143543l and Subsequent (Sheet 2)



AIRPLANES 1435431 AND SUBSEQUENT

The aft fuselage cell level control valve (located in the forward fuselage cell) functions identically to this valve except for the float valve controlling the level control valve electrically instead of by sensing lines.

The primary solenoid of the aft cell level float valve will completely stop fuel flow but the secondary solenoid will permit a flow reduction only.

Figure No. 4-65. Dual Level Control Valve and Dual Level Float Valve (Forward Fuselage Cell)

valve normally will, by remote control, close both primary and secondary valves in the dual level control valve to stop fuel flow to the cells. The fuel flow to the 200-gallon auxiliary tanks or buddy tanks will cease when full due to a level control valve incorporated in each tank. On airplanes 1435431 and subsequent, the refueling system is independent of the wing and forward fuselage tank sump. The fuel flow to the aft cell is picked up from a point forward of the forward fuel cell dual level control valve. The shutoff level of the aft tank is controlled by two float switches, incorporated in one unit (located in the right-hand climb vent fitting in the aft fuselage cell), which electrically controls the dual diaphragm aft fuel cell level control valve. The level control valve is located in the forward fuselage fuel cell at a point slightly forward of the aft fuel cell refuel and transfer line fitting. As the fuel level rises, the secondary or lower float switch actuates, energizing the secondary portion of the shutoff valve, which restricts the flow to approximately 5 gpm. When the fuel level rises above the secondary switch (aft fuel cell is full), the primary (upper) switch actuates and energizes the primary portion of the shutoff valve, stopping the flow of fuel completely. This method of fuel level control is used to prevent overpressurization of the aft fuel cell. A standpipe and check valve are incorporated in the refueling line to ensure complete filling of the aircraft's fuel system. When the forward cell fills first, the standpipe provides gravity flow to the remainder of the fuel system. The sequence of the forward fuselage cell filling first, stopping incoming fuel flow through the action of the dual level control valve and gravity filling of the system through the standpipe, may occur several times during the last few moments of single-point refueling if the quantity of fuel remaining in the aircraft is due to other than the result of normal sequencing. Because of the short time required to fill the fuel cells with fuel (approximately 5 minutes), the dual level control valve should be tested for simulated float valve closing after the first minute of refueling to prevent damage to the fuel cells in the event of a valve malfunction.

4-214. SINGLE-POINT REFUELING DUAL LEVEL CONTROL VALVE AND DUAL LEVEL FLOAT VALVE.

4-215. The dual level control valve (figure 4-65) is located in the forward bottom of the forward fuselage cell and directly above the single-point refueling adapter. The dual level float valve is located in the top and on the right forward side of the forward fuselage cell. The dual level control valve prevents loss of fuel overboard during the single-point refueling process. The valve also prevents damage to the airplane structure from overpressurization of the fuel cells. The dual level control valve consists of two piston valves which are in series flow-wise and duplicate the function of each other. Each piston is held closed by spring tension. After both pistons have been compressed by fuel pressure, a small designed leakage occurs to the inside piston areas, through two flex lines to the dual level float valve (sensing unit). As the fuel level in the forward fuselage cell rises, two floats in

4-216. CHECKING FUEL LEVEL CONTROL VALVES.

CHECKING FUEL LEVEL CONTROL VALVE ON AIRPLANES 139531i THROUGH 141466j

Note

- Apply 28 volt dc external power.
- Perform the following check during the first minute of refueling.

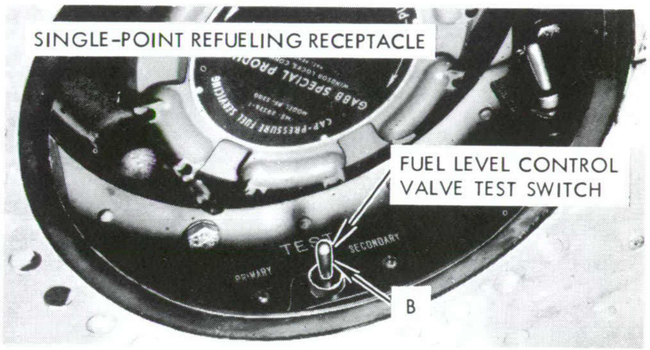
1 Position test switch "B" to "PRIMARY".

2 A definite flow reduction should be noted. (This may be determined by a slight jerk of the refueling hose.)

3 Release switch.

4 Position test switch "B" to "SECONDARY."

5 Repeat steps 2 and 3.



TESTING FUEL LEVEL CONTROL VALVES ON AIRPLANES 141467j THROUGH 143542k

Note Perform the following tests during the first minute of refueling:

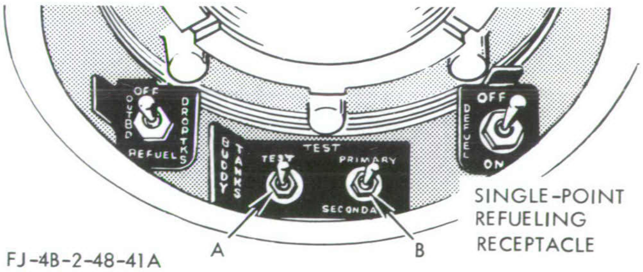
1 Position test switch "A" to "TEST" (up) and "B" to "PRIMARY" (up) simultaneously.

2 Complete flow stoppage should occur without drop tanks or with only buddy tanks installed. With drop tanks installed, a flow reduction should be noted.

3 Release switches.

4 Position test switch "A" to "TEST" (up) and switch "B" to "SECONDARY" (down).

5 Repeat steps 2 and 3.



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the dual level float valve rise and close the two pilot valves. Fuel pressure is then equalized on both sides of the dual level control valve pistons, moving them to the closed position by spring action. When either piston is closed, fuel flow is stopped. If one piston valve should fail, the other piston valve will shut off incoming fuel. A double-throw momentary switch for testing the primary and secondary valves of the dual level float valve is located inside the single-point receptacle door. Holding the switch in either direction closes a solenoid-operated valve on the float chamber drain in the dual level float valve and will decrease the flow of fuel noticeably. Fuel flow will not stop entirely because of the fuel flow of the drop tanks which is routed from the main refueling line before it reaches the dual level control valve.

CHECKING FUEL LEVEL CONTROL VALVES ON AIRPLANES 1435431 AND SUBSEQUENT

Note Perform the following tests during the first minute of refueling.

1 Position test switches "A" to "TEST" (up) and "B" and "C" to "PRIMARY" (up).

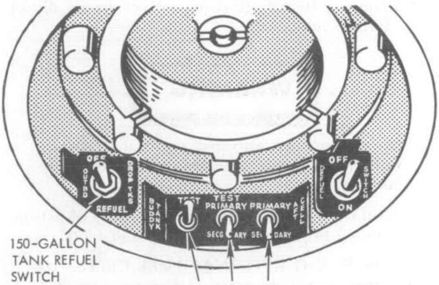
2 Complete flow stoppage should occur without drop tanks or with only buddy tanks installed. With drop tanks installed, a flow reduction should be noted.

3 Release switches.

4 Position test switches "A" to "TEST" (up) and "B" and "C" to "SECONDARY" (down).

5 Repeat steps 2 and 3.

SINGLE-POINT REFUELING RECEPTACLE



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4-217. SINGLE-POINT DEFUELING SYSTEM.

4-218. The single-point defueling system consists of the single-point refueling receptacle, a defueling switch, a line, a check valve and the use of the fuel transfer system. To defuel the airplane, the defueling nozzle is inserted into the refueling receptacle and locked as in single-point refueling. Provide a source of external power.

WARNING

- Place the D.C. POWER switch in the "OFF" position while servicing the airplane with 28-volt external power.
- Place the ENGINE MASTER switch in the "OFF" position while defueling.

Position DEFUEL switch, located inside of the receptacle access door, to the "ON" position. [This procedure will energize the normal sequencing system for the fuel transfer pumps (figure 4-57).] When a negative pressure is applied at the defueling nozzle, fuel will be drawn from the forward fuselage cell through a check valve and out the defueling line. The rate of flow will be approximately 40 gpm with 3 psi negative pressure applied at the single-point receptacle. The DEFUEL switch is mounted so that the receptacle door cannot be closed without turning the switch to the "OFF" position. Defueling can be accomplished without the transfer pumps but at a reduced rate. Approximately 31 gallons will remain in the wing and aft cells in excess of that which remains when the transfer pumps are used to defuel the airplane. The drop tanks or buddy tanks may be defueled individually with a suction hose or by applying dry air pressure at the air pressure manifold [forward engine bulkhead (figure 4-69)] and placing the appropriate switch to transfer (with 28-volt d-c power supplied to airplane). This will transfer drop tank fuel to the internal fuel system for single-point defueling.

4-219. FUEL CELLS.

4-220. The internal fuel is contained in two U-shaped fuselage cells and two integral wing cells, all of which are suitable for aromatic fuel. No individual filler caps are provided for each fuel cell as the fuel system must be filled by the single-point receptacle, located on the underside of the fuselage, directly below the cockpit, or by the in-flight refueling probe. This receptacle is covered by a flush access door. The upper portion of the forward fuselage cell is of a bladder-type construction and the lower portion is a self-sealing-type construction. This provides a self-sealing sump of approximately 100 gallons. The aft fuselage cell is of a bladder-type construction. The integral wing tanks (paragraph 4-234) extend from the inboard end of the wing, outboard to the wing fold, and from the front spar to the aft spar of each wing. The perimeter of the tanks is sealed by an injection groove and attaching screw holes are sealed by "O" rings.

4-221. MAINTENANCE OF FORWARD AND AFT FUSELAGE FUEL CELLS.

4-222. The majority of fuel cell failures are caused by improper handling of the cells. The fuel cells used in the airplane fuselage are made of rubber. Each cell is virtually a handmade item, except for its actual curing. Each individual fitting of the cell is designed for that particular position in which it is placed so as to line up with a like orifice or connection in the airplane structure. The life of the pilot and the safety of the airplane may often depend on the correct functioning of a fuel cell. In combat areas, this is especially true. Therefore, every member of the crew whose duties pertain to the handling and storage of rubber fuel cells should observe the following instructions for the maintenance and care of fuel cells:

a. Always carry or haul fuel cells; never drag fuel cells over any surface.

b. Never leave fuel cells with their fittings untaped or uncovered as dust and dirt will enter the cell. Fuel cells should be clean and free from water or gasoline. Seal all openings (on exterior surfaces only) with masking tape or other suitable material before storing. Leave a small vent hole in one opening so pressure in tank will always be the same as that of the surrounding atmosphere.

c. Never carry a cell around by its fittings. Never use the fittings or openings as handgrips in handling or installing the cell.

d. Never remove the cells from their original shipping container before they are actually needed for installation. Use oldest cells first. Before removing a cell from its container, be sure to detach all carrier straps and hanger fittings.

e. Do not store cells in hot warehouses and storerooms. Never subject cells to direct sunlight. Maintain a constant circulation of air or drafts in rooms where cells are stored. For ideal storage, uncrated cells should be individually supported by placing on shelves in a room which is cool, clean, dark and dry. Temperature must be maintained at 10°C to 18°C (45°F to 65°F).

f. Never allow fuel to spill on the outside of fuel cells. If spillage of fuel should occur, clean cell as soon as possible.

g. Never pry on rubber fittings or cells with sharp instruments.

h. Never allow a hot light bulb to rest on the inside of a cell while making repairs or inspecting. Always be sure to use safety lights inside of cells.

i. A thin coating of light engine oil should be applied to the inner liner of all serviceable fuel cells which have contained fuel when it is evident that the cells will remain without fuel for more than 10 days, whether installed in airplanes or in storage. The oil will prevent the inner liner from drying out or cracking.

j. Always ensure that the self-sealant portion of the cell is completely supported on a flat surface when storing or if cell is to remain out of airplane for more than 20 minutes. Never store or leave a cell upside down or draped over an object as the self-sealant will tend to flow.

k. Do not overtorque fuel cell fittings. Higher torques than those recommended lead to bolt or self-locking failure.

Note

When removing bolts from fuel cell fittings, loosen one-fourth to one-half turn only; then, gently tap the head of the bolt to disengage the self-locking feature and continue to remove bolt.

4-223. PRECAUTIONARY MEASURES FOR PERSONNEL WORKING IN OR AROUND FUEL CELLS.

a. Protective clothing and equipment such as rubber gloves, goggles and a respirator (air supply) will be used as necessary to provide adequate health protection for personnel working in and on fuel cells.

b. All lights must be explosion proot. Power tools must be air-driven. Personnel must wear cotton clothing to avoid building up static charges. Clothing must not be equipped with metal buttons, buckles, etc.

c. Remove all objects from pockets before entering fuel cells.

d. When entering a fuel cell for repair or inspection, the individual must wear a respirator (air supplying, full face piece) or mask and blower. A second man must be stationed outside of the cell in such a position that he can detect any signs of distress shown by the man within the cell. Air used in fuel cells for ventilation must be filtered and completely free of oil, water, solvent vapors, dirt or other foreign substances.

WARNING

Do not use an activated charcoal (organic vapor or paint spray) respirator while working inside a fuel cell.

e. Fuel cells must be purged prior to entry of personnel according to paragraphs 4-224 through 4-228.

4-224. PURGING INTERNAL FUEL CELLS.

4-225. Prior to entering or removing the forward or aft fuselage fuel cells, purging must be accomplished to prevent injury to personnel due to fuel vapors.

WARNING

- During defueling and purging, the aircraft must be located not less than 100 feet from any building, smoking area, other aircraft, or any source of ignition.
- The aircraft must be statically grounded and fire-fighting equipment available for petroleum fires.

4-226. PURGING FORWARD FUSELAGE CELL. To purge the forward fuselage cell, see figure 4-66 and proceed as follows:

Note

It is not necessary to defuel the entire fuel system to purge the forward cell if the proper lines are disconnected (step a.).

a. Disconnect the quick-disconnect coupling (A) in the aft transfer line at the field break.

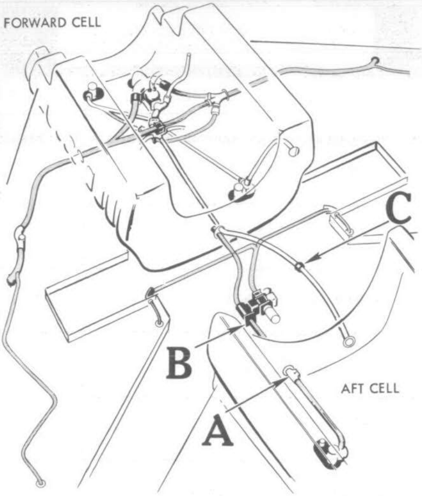


Figure No. 4-66. Disconnect Points for Purging Internal Fuel Cells

b. Defuel the airplane (paragraph 1-35).

c. Disconnect the aft transfer line at the B-nut fitting (B) on the wing transfer pump assembly.

d. Apply dry air at a maximum of 3½ psi to (B) (figure 4-66) until the discharge of purging air at the fuel vent bayonet shows a safe reading with an explosion meter. (This procedure will eliminate small puddles of fuel from the bottom of the cell.)

e. Disconnect dry air connection at (B) and apply nitrogen pressure until fuel vapors at fuel vent bayonet are eliminated.

WARNING

- The purging gas (dry air, nitrogen, etc) must be between −65°F to +165°F to preclude damage to fuel cells, fittings and seals.
- Purging fuel cells normally will only provide adequate protection for a maximum of 24 hours. It is recommended that purging be checked every 4 hours and cell repurged as necessary.
- Whenever personnel are inside the fuel cell, a constant purging with dry air is recommended. (This procedure can be accomplished by supplying the dry air through one of the disconnected cell fittings.)

4-227. PURGING WING TANKS. To purge wing tanks, see figure 4-66 and proceed as follows:

a. Disconnect the single-point refueling line to the aft cell at the B-nut coupling (C).

b. Disconnect the transfer line to the aft cell at (A).

c. Defuel airplane (paragraph 1-35).

d. Repeat steps d. and e. of paragraph 4-226 using purging point (C) instead of (B). Connect purging supply air or nitrogen to forward section of line.

4-228. PURGING AFT FUSELAGE CELL. To purge the aft fuselage cell, see figure 4-66 and proceed as follows:

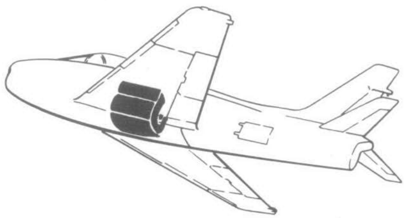
a. Defuel the airplane (paragraph 1-35).

b. Disconnect the single-point refueling line to the aft tank at the B-nut coupling (C).

c. Refuel the airplane (paragraph 1-34). (This procedure will refuel the forward fuselage cell and the wing tanks only as long as the aft cell is empty because of the disconnected refueling line.)

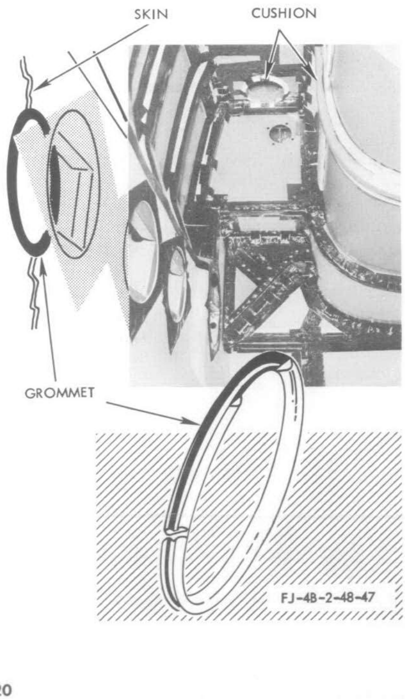
d. Repeat steps d. and e. of paragraph 4-226 using purging point (C) instead of (B). Connect purging supply air or nitrogen to aft section of this line.

4-229. APPLICATION OF ANTI-CHAFING TAPE.



1 Cement grommets in place using rubber adhesive (item 3, materials list).

2 Cement cushions in place using synthetic rubber adhesive (item 4, materials list).



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APPLICABLE MATERIALS USED IN APPLYING ANTI-CHAFING TAPE

MATERIAL	ITEM * NO.
RUBBER ADHESIVE	3
SYNTHETIC RUBBER ADHESIVE	4
ALIPHATIC NAPHTHA	91
ANTI-CHAFING TAPE (SCOTCHCAL NO. 455)	126
TAPE ADHESIVE ACTIVATOR (TYPE A2)	126
FELT SQUEEGEE (NO. SQ 1) (MINNESOTA MINING AND MANUFACTURING CO)	
PLASTIC HAND APPLICATOR (PA-1) (MINNESOTA MINING AND MANUFACTURING CO)	
SEALING COMPOUND	128
METHYL-ETHYL-KETONE	90

*Refer to the materials list in General Information, Section IV for correct type of consummable material.

3 Inspect to be sure that all sharp edges and burrs are removed. Anti-chafing tape must be used to cover all tooling holes, lap joints, fasteners, butt joints and any sharp edges in fuel bays prior to installing fuel cells. The tape will prevent chafing and damage to the cells.

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INSTALLATION OF ANTI-CHAFING TAPE IN FUEL BAY AREAS

4 CLEAN AREA TO BE TAPED IN FOLLOWING MANNER:

A. Using an air hose or clean dry cloth, remove dust, chips, etc, from the surface to be taped.

B. Wipe all surfaces to be taped with a clean cloth moistened with aliphatic naphtha (item 91, materials list).

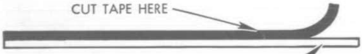
Note

- It is essential that clean dry cloths be used. Soiled cloths should be discarded.
- To avoid contamination of the solvent, it should always be poured from the container onto the cloth. Never dip cloths into the solvent.
- When cleaning priming areas, the primer adhesion should be checked by scraping with the thumbnail. Loose primer must be removed from the area to be taped.

Warning All safety precautions must be observed when using the solvent. (Refer to paragraph 4-223.) Forced ventilation must be provided if it is used in a closed area.

C. Repeat cleaning procedure until the areas to be taped are absolutely clean.

5 Remove protective liner from tape.



Note

- The liner should be removed from the anti-chafing tape (item 126, materials list) only as necessary. Cut tape to desired length. Leave interliner extended beyond edge of unused tape.
- Activate tape with tape adhesive activator (item 126, materials list). Apply activator to surface of tape from which the liner was removed by using the felt squeegee saturated with activator.

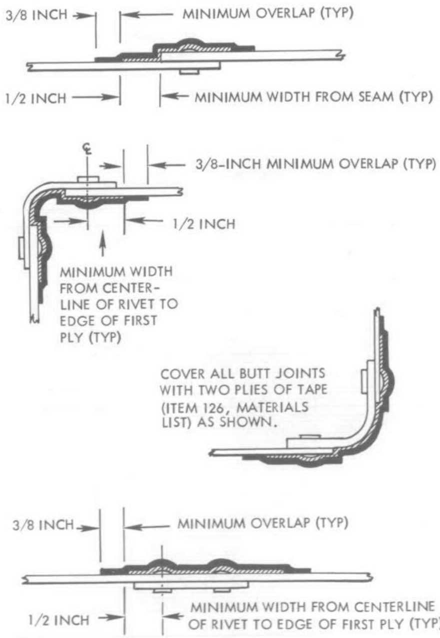
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Warning The activator has a harmful effect on fuel cells; therefore, extreme care is required to ensure that no liquid activator or parts dampened by activator come in contact with fuel cells.

Note The activator is a nontoxic liquid. The hands should be protected since the activator has a tendency to harden cuticles. The activator has an odor which may be undesirable; therefore, it should be applied in a well ventilated area.

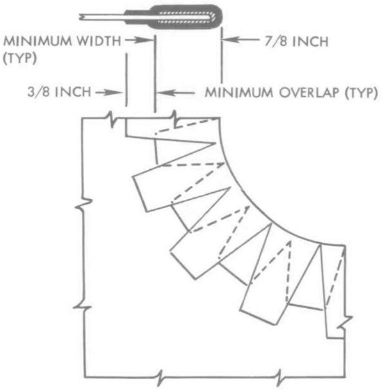
6 Apply activated tape to cleaned area.

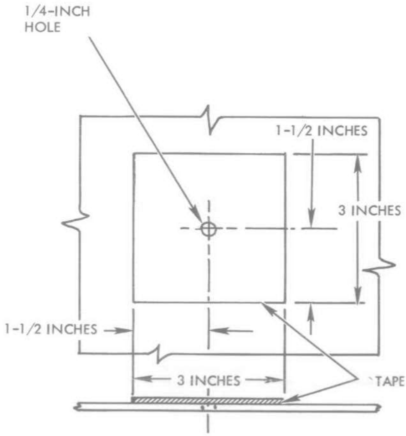
Note If tape cannot be applied within 5 minutes, it must be reactivated. Start at one end and press tape down firmly and smoothly with plastic hand applicator. To ensure good adhesion, the tape should be worked down by wiping outward from the center of the tape with reasonable pressure. Wrinkles and air pockets should be avoided.



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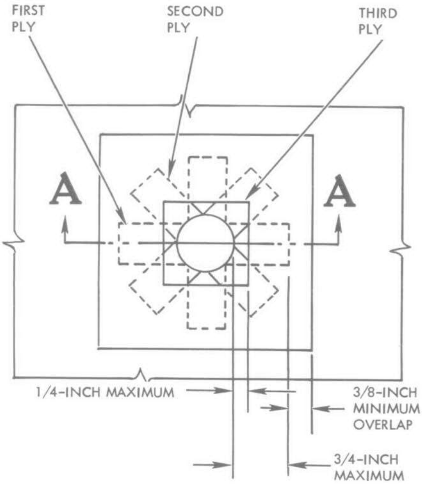
On holes larger than one inch, tape around unflanged holes using two plies of tape (item 126, materials list) as shown.



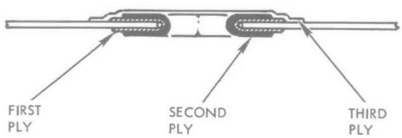


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On holes one inch or less, tape around unflanged holes using three plies of tape as shown.



VIEW A - A

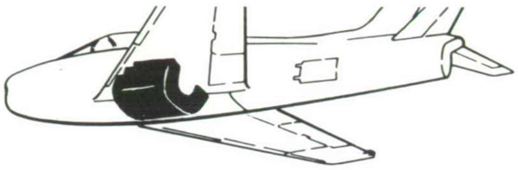


7 Overcoat all antichafing tape with sealing compound (item 128, materials list) for added fuel resistance. If necessary, the sealing compound may be thinned with methyl-ethyl-ketone (item 90, materials list).

Warning The solvent in the sealing compound and the thinner are both highly inflammable. All safety precautions must be observed during their use. Forced ventilation must be provided if they are used in a closed area.

FJ-4B-2-48-52

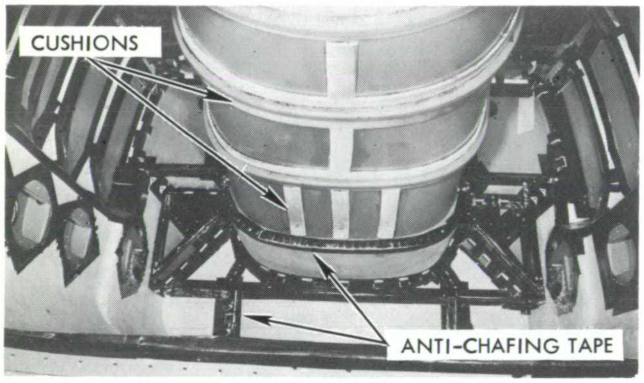
4-230. REMOVING AND INSTALLING FORWARD FUSELAGE FUEL CELL. (Illustration.)



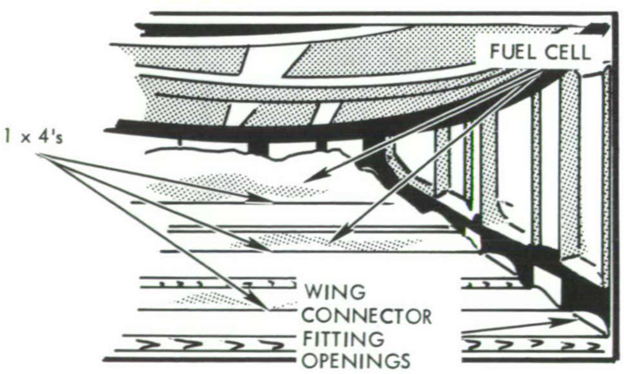
The removing procedure is essentially the opposite of installing. Be sure to observe all precautionary measures for working in or around fuel cells. (Refer to paragraphs 4-221 and 4-223

1 For proper method of handling and preparing the fuel cell for installation, refer to paragraph 4-223 For precautionary measures for personnel working in or around fuel cells, refer to paragraph 4-221.

2 Thoroughly check the fuel cell compartment for cleanliness. Any trapped debris such as bits of wire or loose washers could seriously damage the fuel cell after installation. If the protective tape becomes wet and soggy from leaking fuel, the tape must be replaced. Check the compartment for smoothness of contours. It is important that all exposed rivet or bolt heads and edges of structure, such as seam joints and protrusions, be rounded off and covered with protective tape.



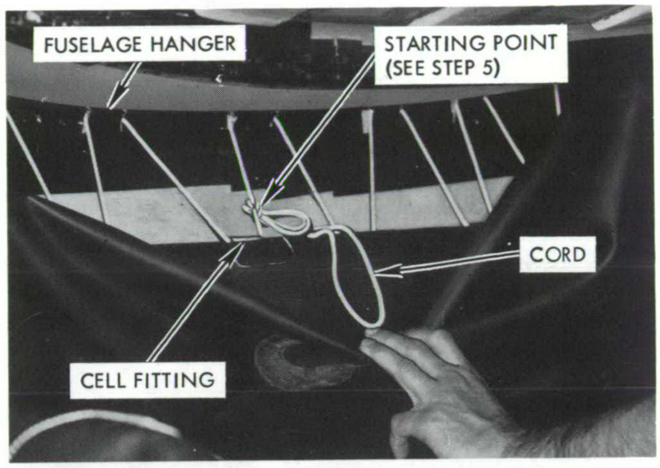
3 Carefully collapse the fuel cell and place it in the forward fuselage cell compartment. Position three smooth 1 x 4's across the top of cell with the ends positioned in the wing connector fitting openings to keep the cell compressed.

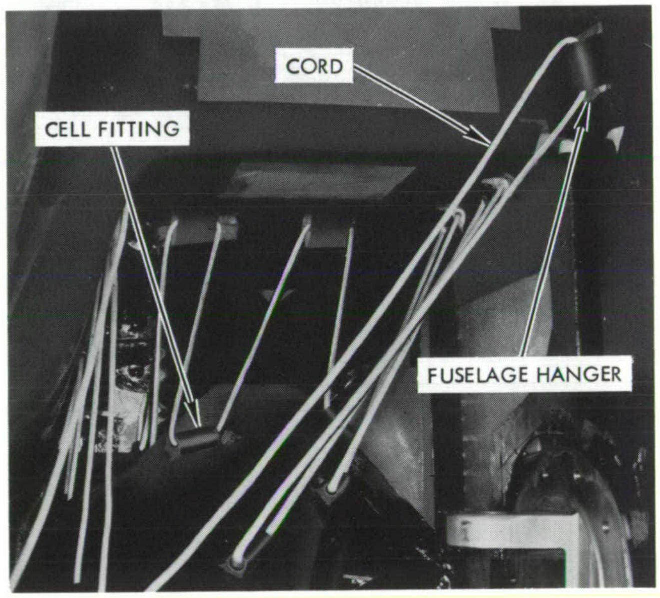


Caution Avoid buckling the cell, particularly near the fittings.

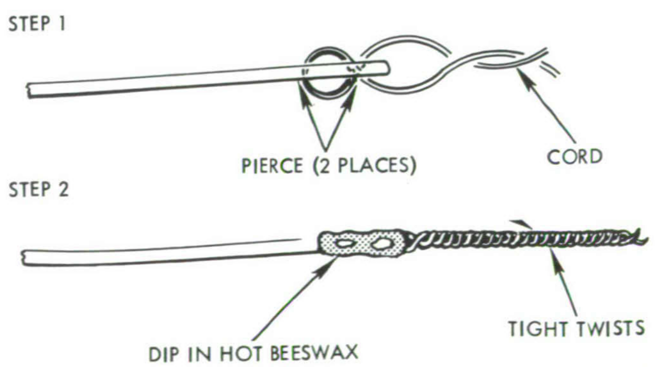
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4 With cell and fuselage fitting holes approximately aligned, begin to loosely lace fuel cell to fuselage. This may be accomplished by crawling in on top of aft end of cell. Thread the cord (item 38, materials list) alternately through cell fitting and fuselage hangers.





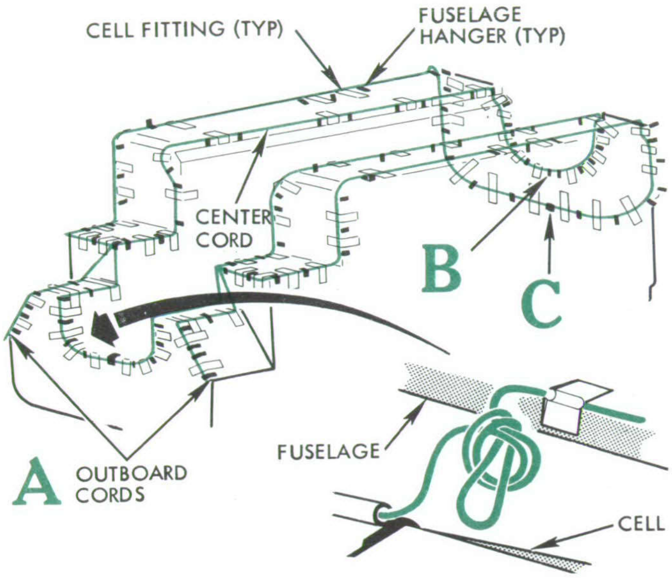
Note The cord can be more easily threaded through the hangers and fittings if the end is pierced and wrapped with tight twists of a length of lockwire.



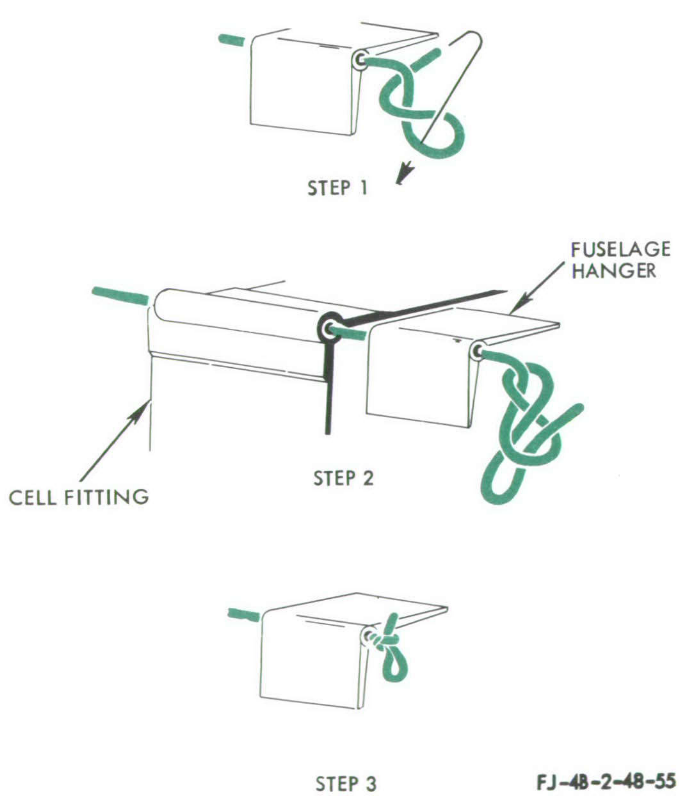
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5 Progressively pull cord taut until all cell fittings and fuselage hangers are strung. Tie ends of cord with knot, as shown, and dip ends of cords in hot beeswax to prevent unraveling.

Note Outboard cords to be 15 feet each in length. Center cord to be 25 feet in length.

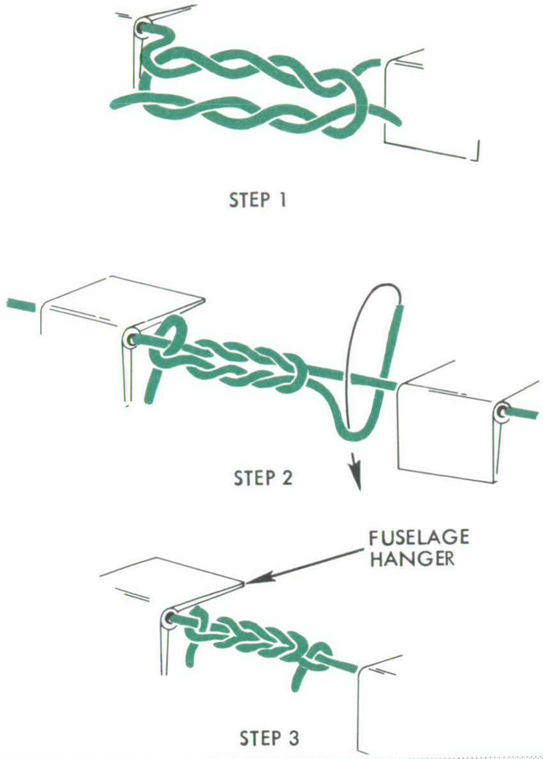


DETAIL A

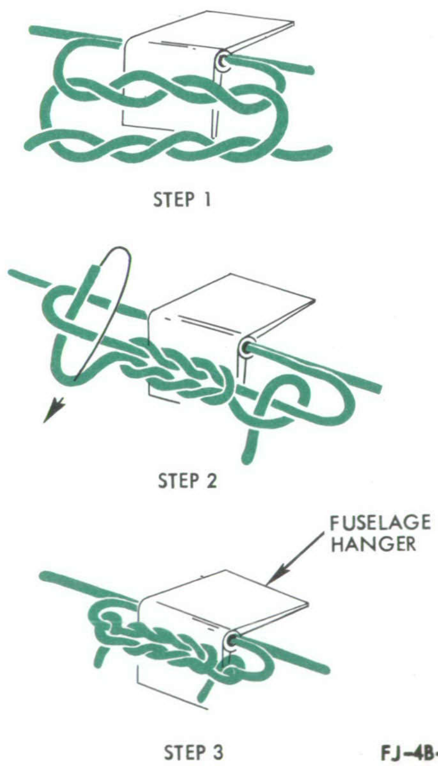


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DETAIL B

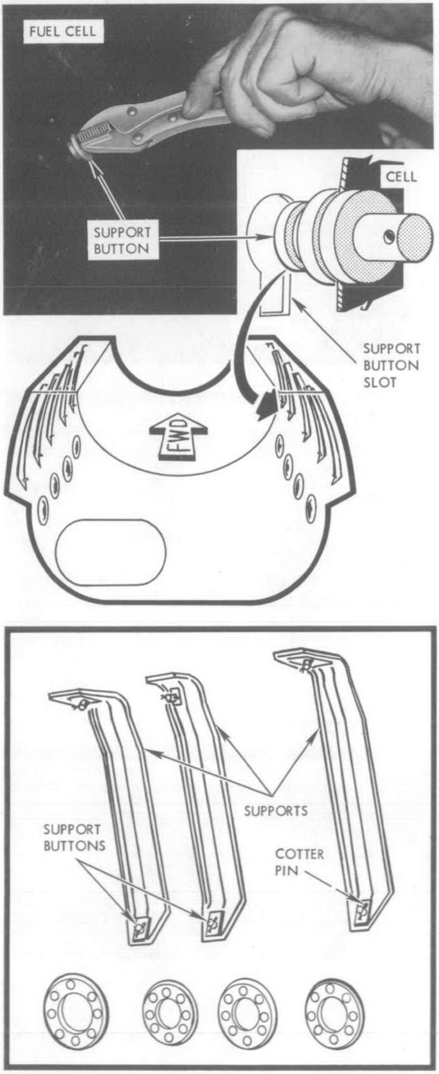


DETAIL C



FJ-4B-2-48-56

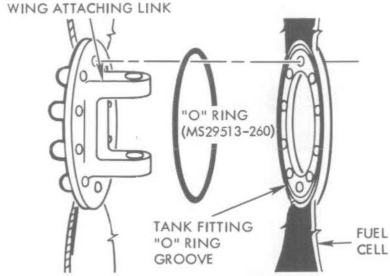
6 Fasten the ten support buttons in the support button slots on each side of cell and install supports on each side of cell.



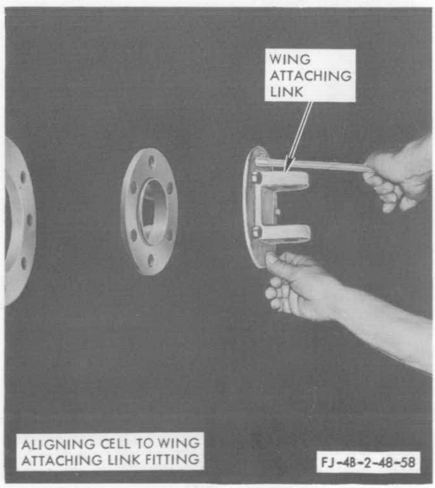
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Note

- Torque all fuel cell fitting bolts from 50 to 70 inch-pounds.
- Torque all Marman coupling nuts to 90 (± 5) inch-pounds, unless otherwise specified.



7 Lubricate "O" ring with petrolatum (item 100, materials list) and position in tank fitting groove on outboard side of wing attaching link opening. (See figure 4-7.) Align attaching holes with wooden dowel and install bolts. Torque bolts from 50 to 70 inch-pounds. Repeat this on opposite side of cell.

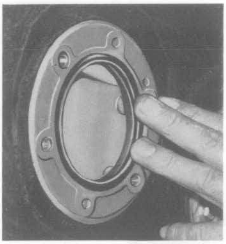


ALIGNING CELL TO WING ATTACHING LINK FITTING

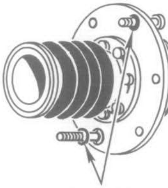
FJ-4B-2-48-58

8 Mate fuel vent, refueling and drop tank wing interconnector fittings to cell and fuselage structure at each side of cell. Use mounting bolts at top and bottom of fitting for alignment only.

A. Install large "O" ring.

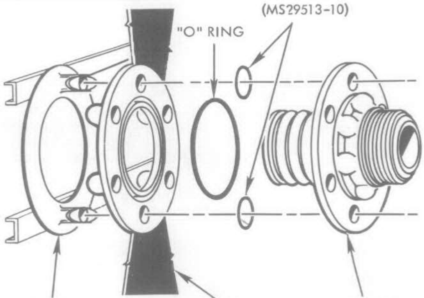


B. Install small "O" ring.

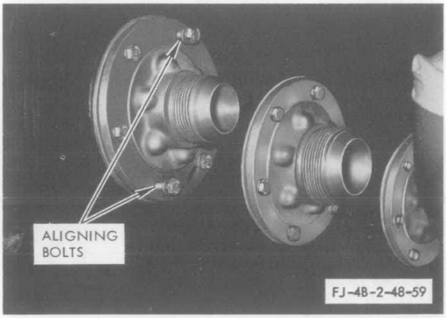


Note For correct size of large "O" rings, see charts following step D.

TYPICAL INSTALLATION

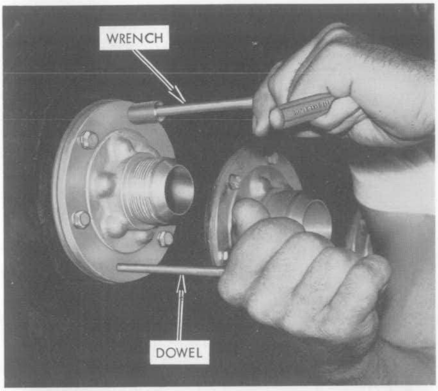


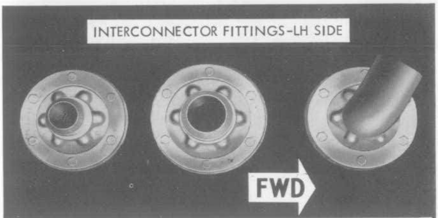
C. Bolt fitting to cell. Remove two bolts used for aligning "O" rings.



FJ-4B-2-48-59

D. Align cell and interconnector fitting with fuselage. Install top and bottom mounting bolts.





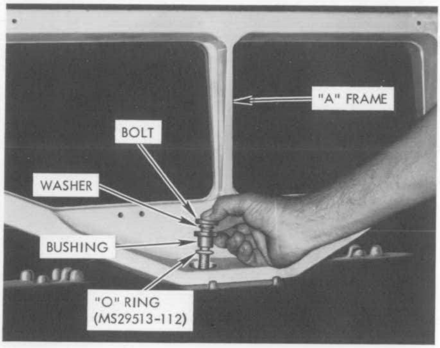
WING REFUELING "O" RING (MS29513-237)	DROP TANK "O" RING (MS29513-240)	FUEL VENT "O" RING (MS29513-237)

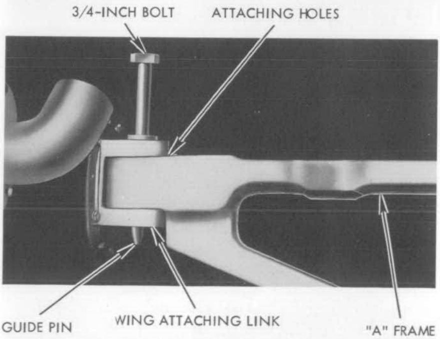


FUEL VENT "O" RING (MS29513-237)	DROP TANK "O" RING (MS29513-240)	WING REFUELING "O" RING (MS29513-237)

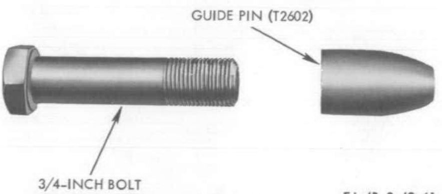
FJ-4B-2-48-60

9 Position "A" frame in place and align the four bottom attaching holes. Install bolts (with bushings only) for a trial fit. Remove the four bolts and bushings and reinstall with "O" rings. (This procedure is important because damage to the "O" ring could result from improper alignment.) Torque bottom "A" frame bolts to 1000 (±10) inch-pounds.



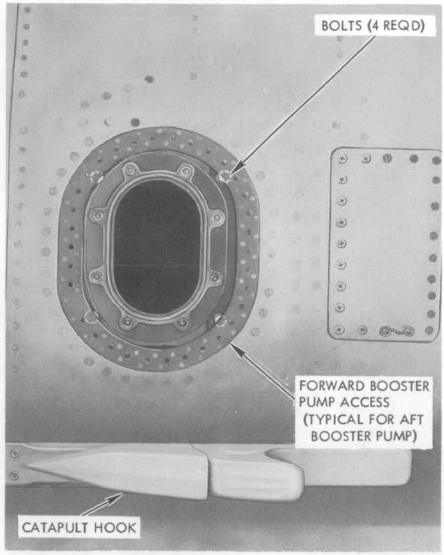


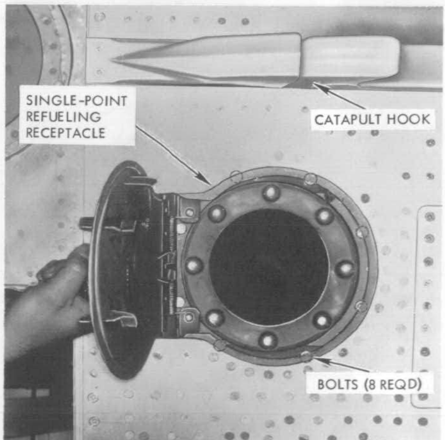
10 Align end attaching holes of "A" frame with wing attaching link using guide pin (P/N T2602) and 3/4-inch bolt. Remove 3/4-inch bolt when guide pin protrudes from bottom of hole and install "A" frame end bolt. Torque "A" frame end bolts to 3000 inch-pounds.



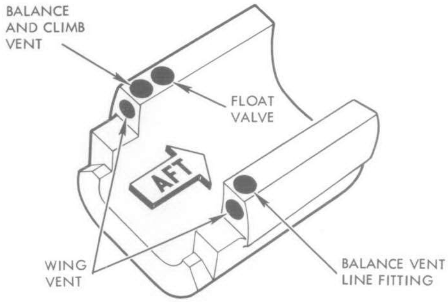
FJ-4B-2-48-61

11 Bolt bottom of cell to structure from underneath fuselage at both booster pump access locations and single-point refueling receptacle.



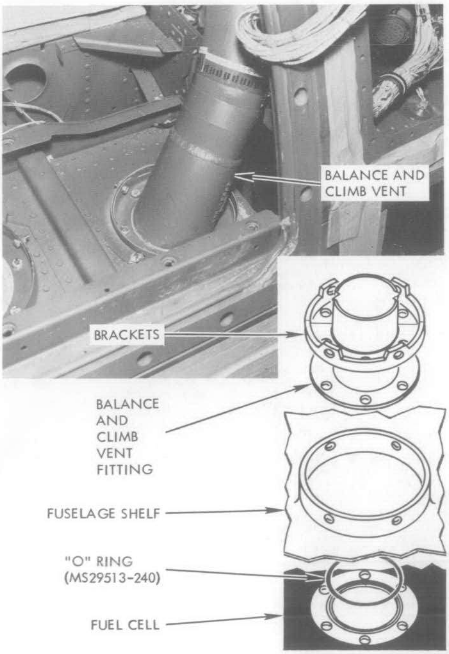


FJ-4B-2-48-62



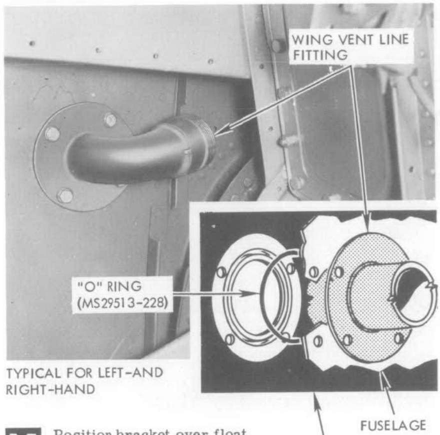
12 Position the balance vent line brackets on top of balance and climb vent fitting and install to fuel cell on right-hand side. Connect brackets to fuselage shelf; then connect fuel balance vent line.

13 Duplicate step 12 on left-hand side (balance vent line) using MS29513-228 "O" ring.

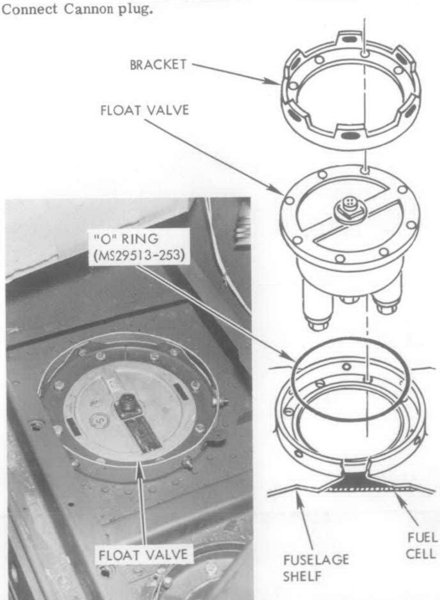


FJ-4B-2-48-63

14 Install left- and right-hand wing vent line fitting to fuel cell and fuselage structure. Connect left- and right-hand wing vent lines.



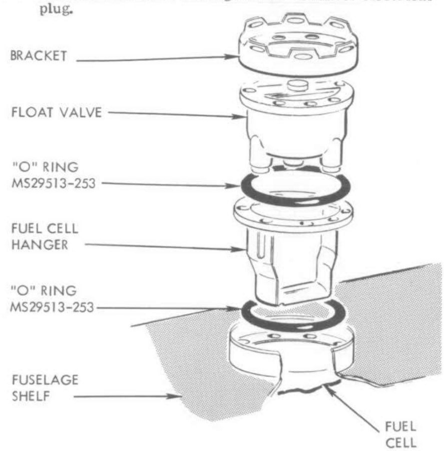
15 Position bracket over float valve and install to fuel cell. Connect bracket to fuselage shelf. Connect Cannon plug.



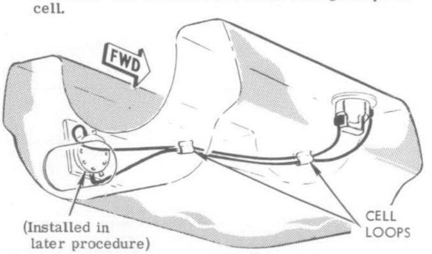
FJ-4B-2-48-64

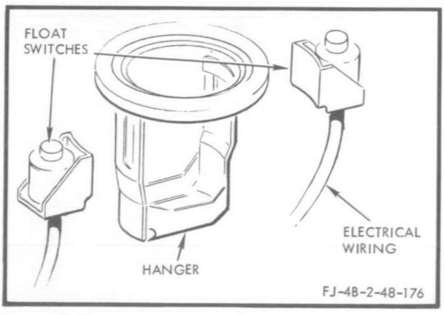
Note Installation procedure for airplanes 1435431 and subsequent.

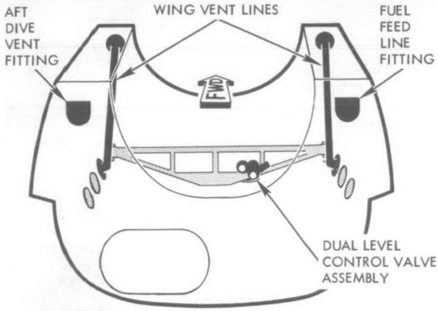
1. Position float switch hanger in fuel cell (insert "O" ring between hanger flange and cell and insert second "O" ring in groove on hanger face). Position float valve and bracket over hanger and install to cell. Connect bracket to fuselage shelf. Connect electrical plug.



2. Install two float switches to hanger from inside of fuel cell. Thread electrical wires through loops on cell.

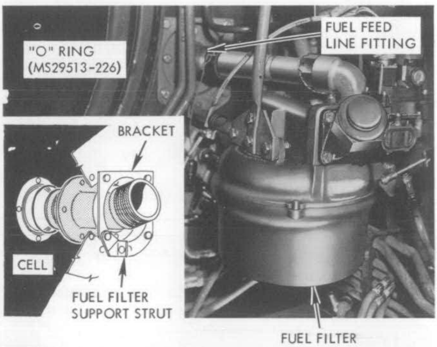




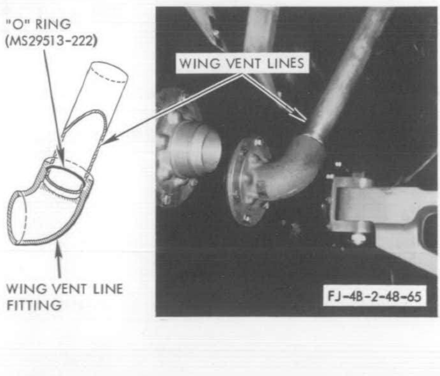


16 Position bracket over fuel feed line fitting and install to fuel cell. Be sure to mount fuel filter strut support to fuel feed line fitting. Connect line to fuel filter.

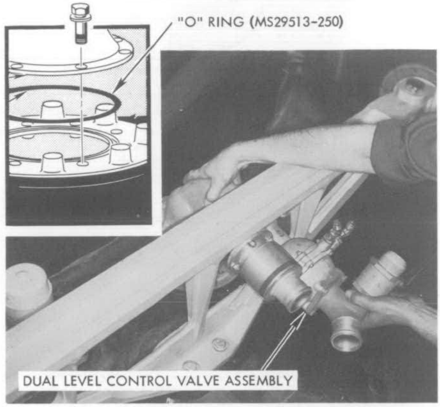
17 Position bracket over aft dive vent. Using MS29513-231 "O" ring, connect dive vent line.

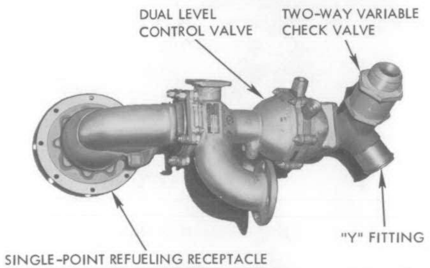


18 Install left- and right-hand wing vent lines.

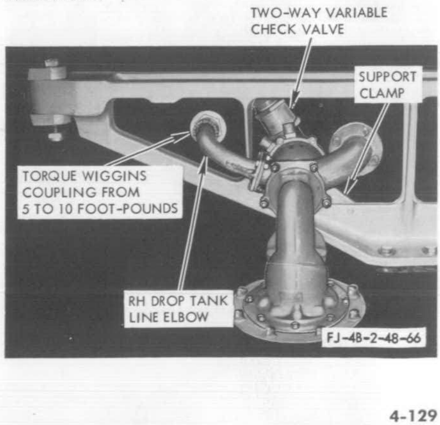


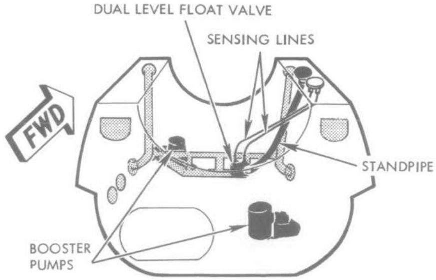
19 Install dual level control valve assembly to bottom of fuel cell. Install support clamp to "A" frame.





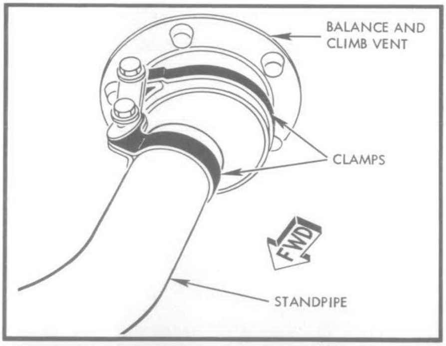
20 Install right-hand drop tank transfer, refueling line elbow and two-way variable check valve to dual level control valve.

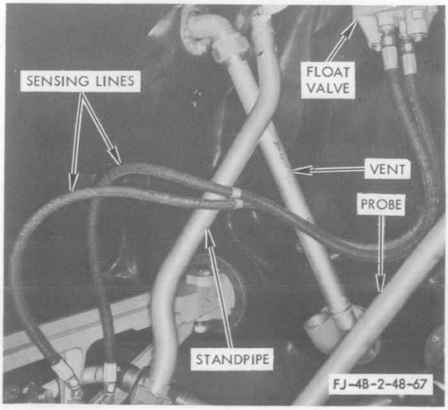


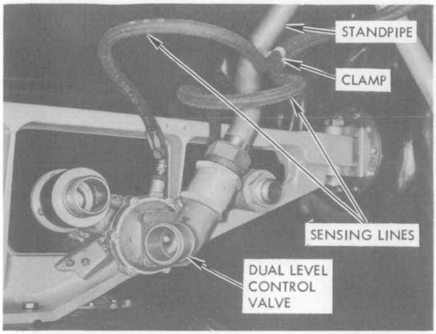


21 Install standpipe and fasten to balance and climb vent with clamps.

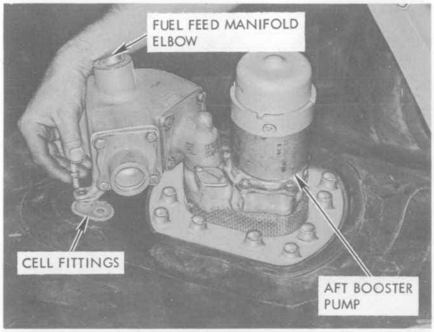
22 Install sensing lines from dual level control valve to fuel level float valve. Clamp sensing lines to standpipe.



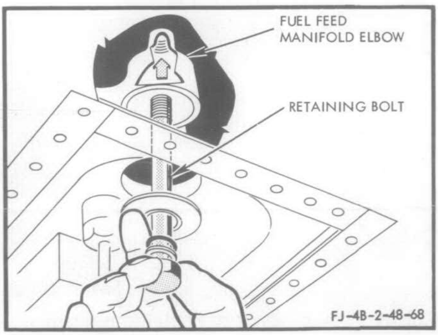




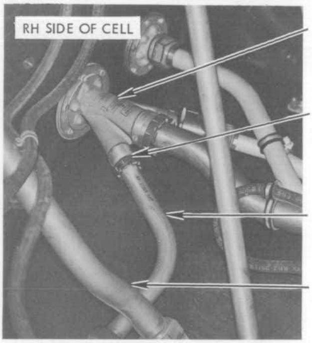
23 Install forward and aft booster pumps. Do not install aft booster pump elbow retaining bolt at this time. (See figure 4-55.)



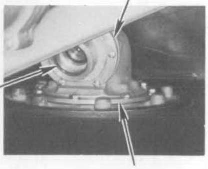
24 Install fuel feed manifold to cell fittings and to aft booster pump. Complete aft booster pump installation by installing fuel feed manifold elbow retaining bolt.



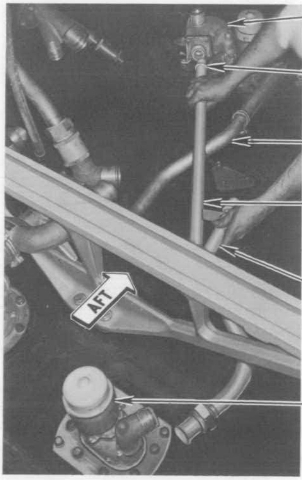
25 Connect drop tank fuel transfer line and right-hand drop tank outlet from dual level control valve to "W" fitting.



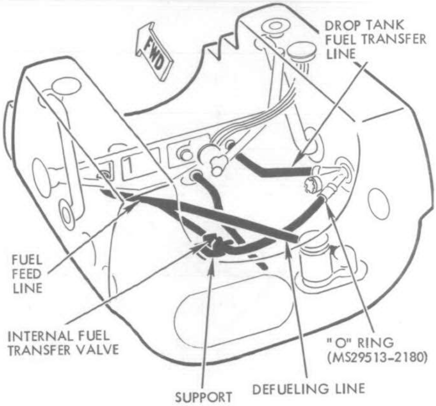
26 Connect defueling line to dual level control valve.



27 Connect fuel feed line from forward booster pump to aft booster pump fuel feed manifold.

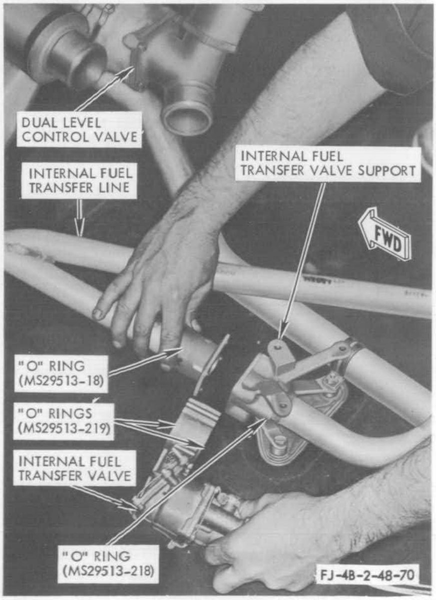


FJ-4B-2-48-69

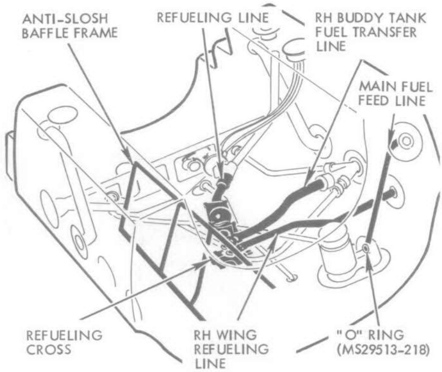


28 Bolt internal fuel transfer valve support to bottom of fuel cell. Clamp defueling line to valve support. Connect internal fuel transfer line from support to "W" fitting.

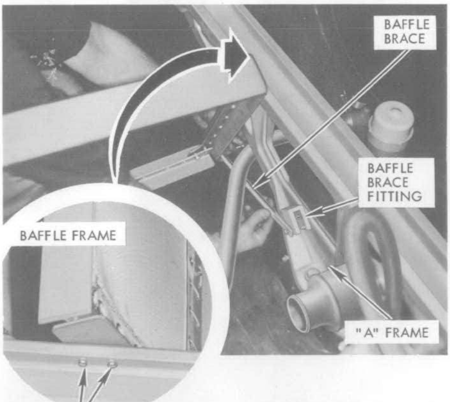
29 Install internal fuel transfer valve.

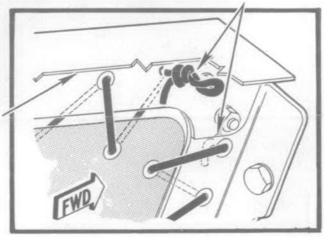


FJ-4B-2-48-70



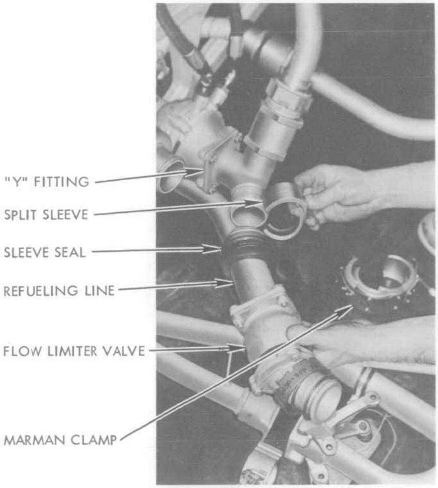
30 Install anti-slosh baffle frame. (Do not install aft support or aft frame channel at this time.) Begin lacing baffle in place using two 13-foot sections of cord (item 38, materials list). Tie cord with overhand knot using double strand of cord.



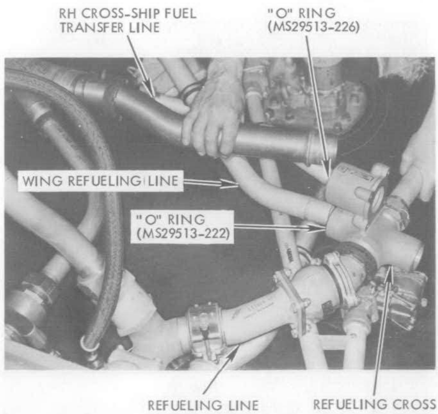


FJ-4B-2-48-71

31 Connect refueling line (incorporating flow limiter valve) to "Y" fitting of dual level control valve assembly. Torque Wiggins coupling to 40 (+5/-0) foot-pounds.

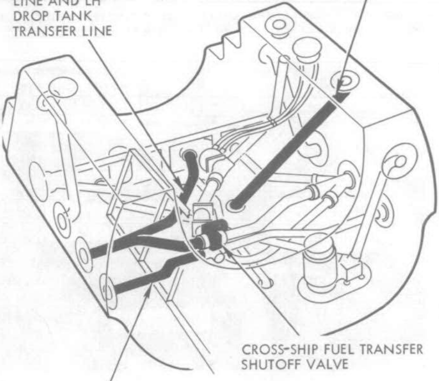


32 Connect refueling line and right-hand cross-ship fuel transfer line to refueling cross simultaneously. Connect refueling cross to internal fuel transfer valve support.



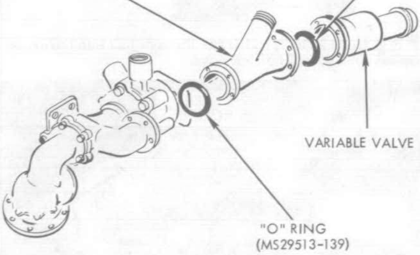
33 Install right-hand wing refueling line and main fuel feed line.

FJ-4B-2-48-72



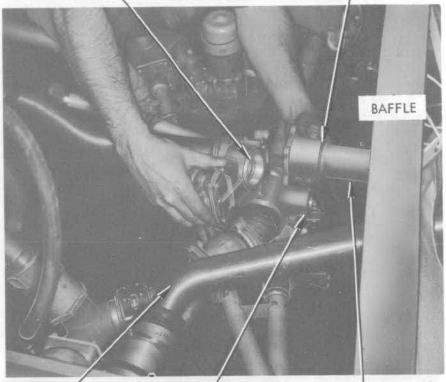
34 Connect left-hand buddy tank cross ship fuel transfer line and left-hand drop tank transfer line to cell fitting at left-hand side of cell and to single-point refueling assembly. Install cross ship fuel transfer shutoff valve and fitting at refueling cross.

34A On airplanes 143543l and subsequent, install transfer tee and variable valve assembly to single-point refueling assembly and connect left-hand buddy tank cross ship fuel transfer line and left-hand drop tank transfer line to cell fitting at left-hand side of cell.



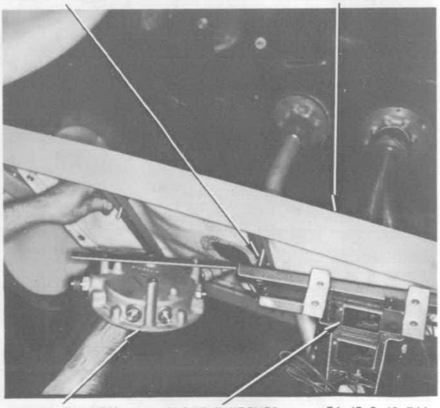
FJ-4B-2-48-73A

35 Connect left-hand wing refueling line between left-hand cell fitting and refueling cross.



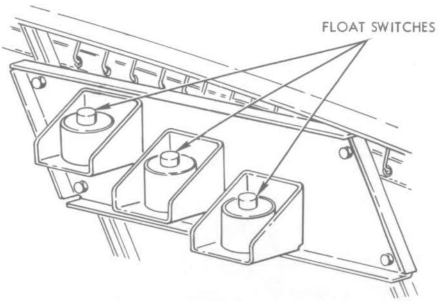
36 Install right-hand fuel probe. (Refer to paragraph 6-335.)

37 Install junction box and float switch assembly (consisting of five float switches) on right-hand side of anti-slosh baffle.

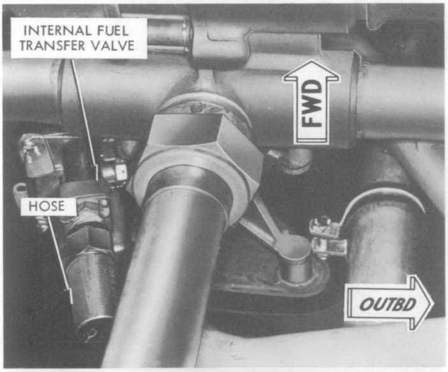


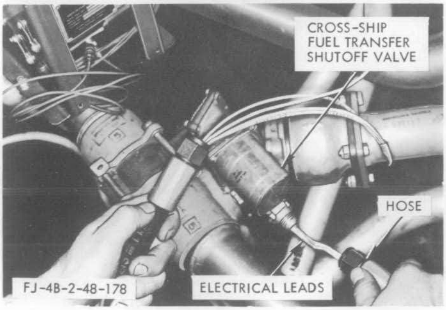
FJ-4B-2-48-74A

37A On airplanes 1435431 and subsequent, install junction box and float switch assembly (consisting of three float switches) on right-hand side of anti-slosh baffle.



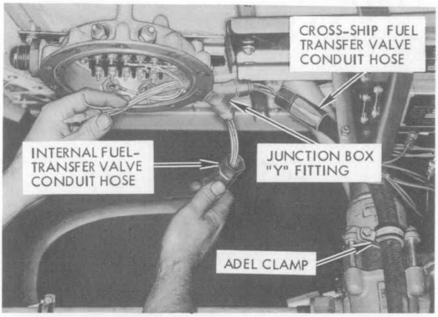
38 Thread electrical leads through cross ship fuel transfer valve connecting hose and connect hose to valve. Thread electrical leads through internal fuel transfer valve hose and connect hose to valve.



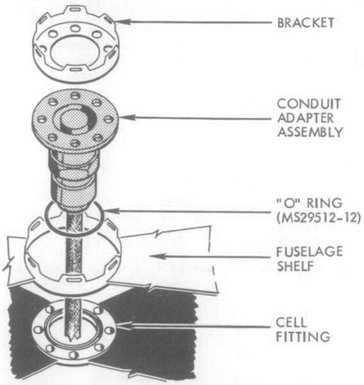


FJ-4B-2-48-178

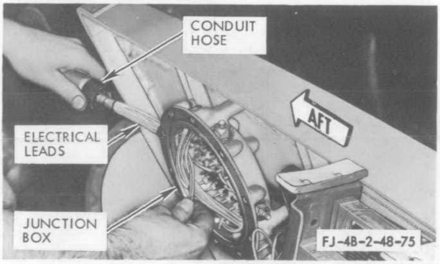
39 Thread electrical leads from internal fuel transfer valve and cross-ship fuel transfer valve through "Y" fitting on electrical junction box. Install internal fuel transfer valve and cross-ship fuel transfer valve electrical conduit hoses to "Y" fitting. Install Adel clamp as shown.



40 Install conduit adapter assembly to fuel cell fitting.

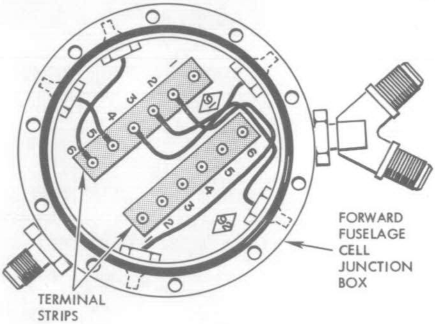


41 Thread electrical leads through junction box outlet and connect conduit hose.

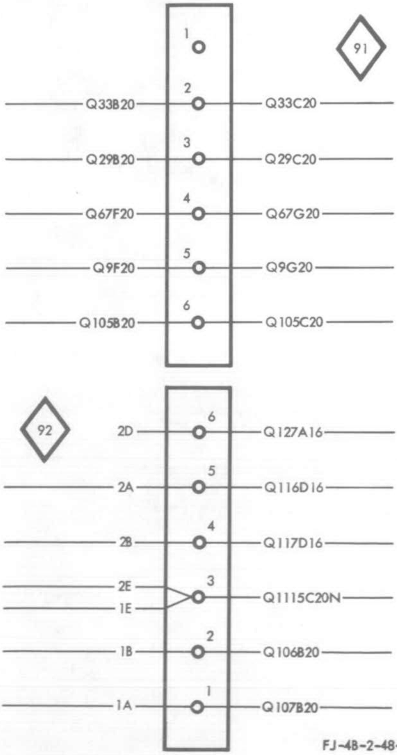


FJ-4B-2-48-75

42 Connect electrical leads to terminal strips in forward fuselage cell junction box.

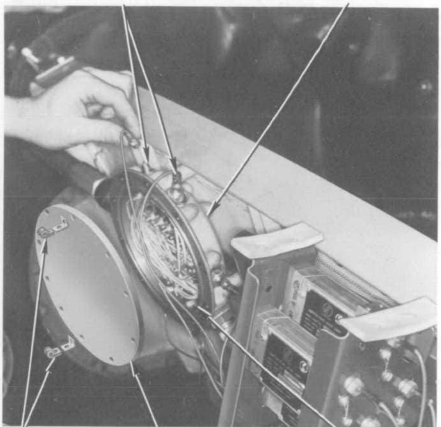


WIRING DATA FOR JUNCTION BOX

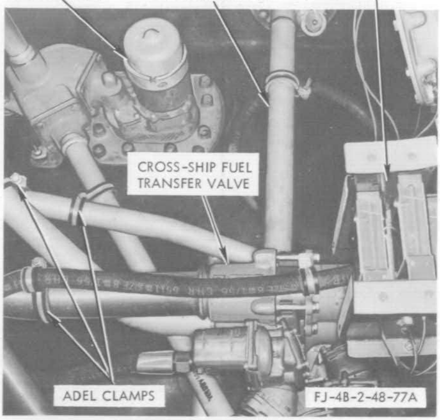


FJ-4B-2-48-76

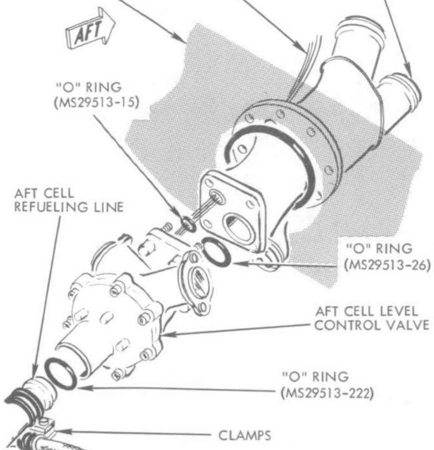
43 Install cover plate on junction box. Connect the five Dage quick-disconnects to the Dage receptacles on the junction box. Clamp the two electrical leads from the float switches mounted on the float valve to the junction box.



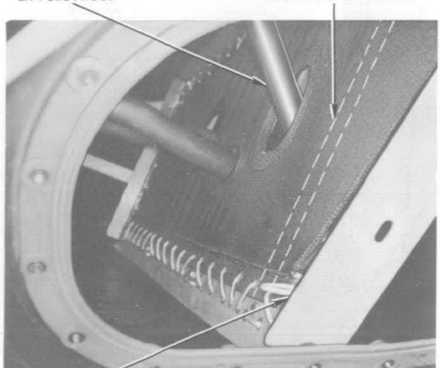
44 Install aft cell refueling line. Install Adel clamps to fuel lines and hoses as shown.



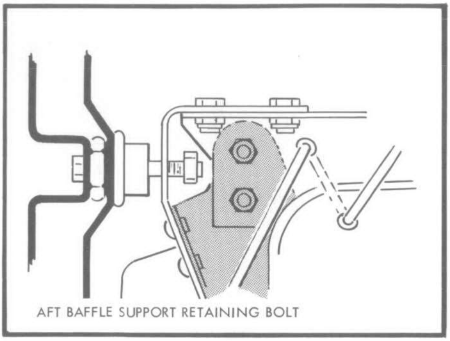
44A On airplanes 1435431 and subsequent, position aft cell refueling and transfer fitting to forward fuel cell and install aft cell level control valve to fitting (thread electrical leads through fitting before installing valve). Install aft cell refueling line, clamps and electrical hose.

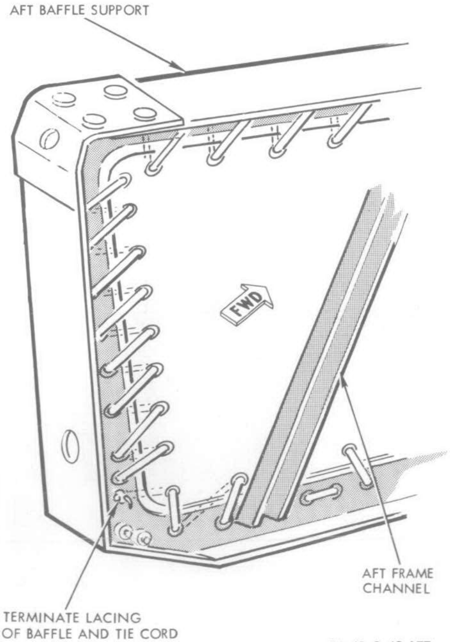


45 Install left-hand fuel probe. (Refer to paragraph 6-335.)



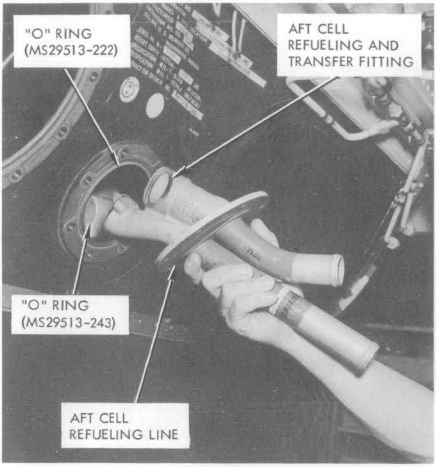
46 Install aft baffle support and aft frame channel. Complete the lacing of the baffle to the baffle frame. Tie cord with overhand knot using double strand of cord as shown in step 30.



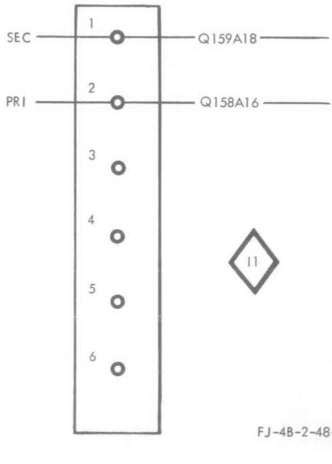


FJ-4B-2-48-177

47 On airplanes 139531i through 143542k,position aft cell refueling and transfer fitting to forward fuel cell. (Do not install retaining bolts at this time.) Be sure to position aft cell refueling line inside end of fitting.

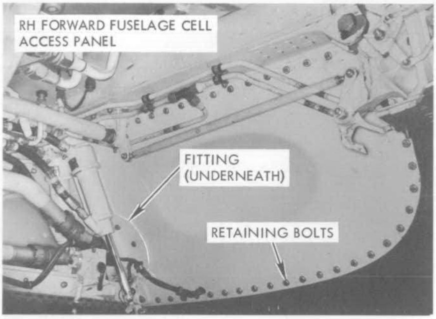


47A On airplanes 143543l and subsequent,connect electrical leads to terminal strip No. 11. Connect electrical ground leads to fuselage structure.

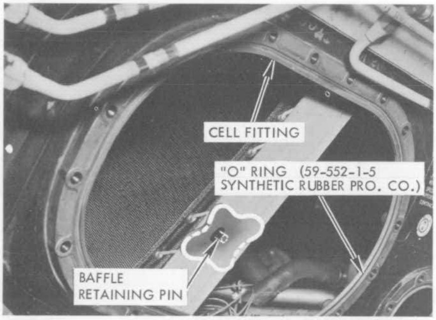


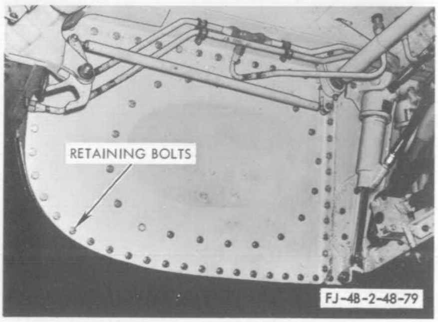
FJ-4B-2-48-195

48 Install right-hand forward fuselage cell access door by aligning door with aft cell refueling and transfer fitting and then bolting to fuel cell. Align and install remainder of access door retaining bolts.

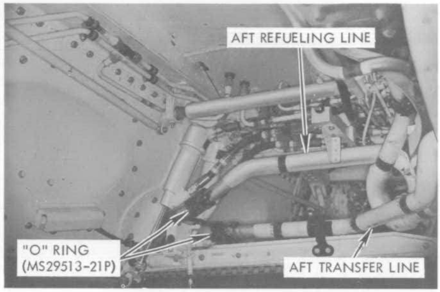


49 Align left-hand forward fuselage cell access door with cell and bolt access door to cell fitting to retain "O" ring. Align and install remainder of access door retaining bolts.

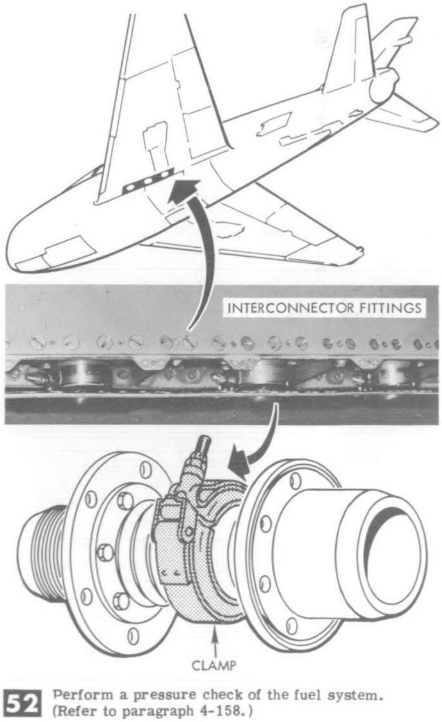




50 Install the aft transfer line, refueling line and structure and hydraulic equipment at the forward web of the main landing gear wheel wells.



51 Connect fuel tank to wing interconnector fittings on left- and right-hand wings. Install hydraulic lines and fairing.



52 Perform a pressure check of the fuel system. (Refer to paragraph 4-158.)

FJ-4B-2-48-80

4-231. REMOVING AND INSTALLING AFT FUSELAGE FUEL CELL.

REMOVING

Note Purge cell according to paragraph 4-228. Follow instructions on maintenance of fuel cells (paragraph 4-221) and comply with paragraph 4-223.

1 Remove aft transfer pump. Refer to paragraph 168.)

2 Remove aft fuselage. (Refer to paragraph 2-6.)

3 Remove any obstructing hydraulic lines.

4 Remove cell drain fitting from sump drain bracket.

5 Remove quick-disconnect from refueling fitting. Remove refueling fitting from cell.

6 Remove quick-disconnect fitting from fuel transfer fitting. Remove fuel transfer fitting with transfer line and transfer pump elbow connected.

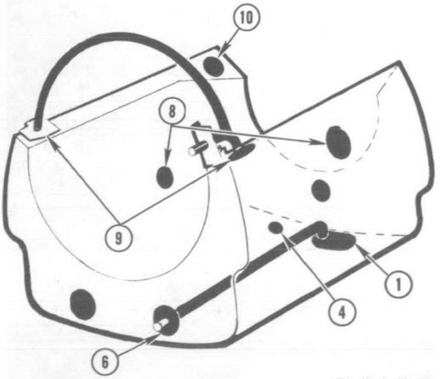
7 Remove aft fuel cell access cover.

8 Remove fuel probes from aft fuselage cell and fuselage structure (one on each side).

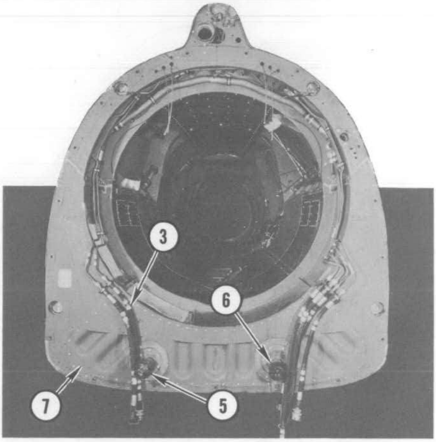
9 Disconnect climb vent line from climb vent line fitting (left- and right-hand sides) and remove climb vent line fittings from fuel cell (one on each side).

10 Remove dive vent fitting from fuel shelf and fuel cell.

11 Remove all cell hangers and remove cell from fuel cell bay.



FJ-4B-2-48-83

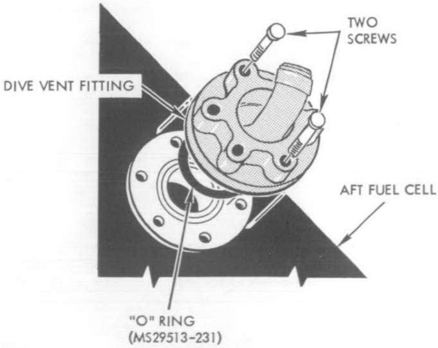


INSTALLING

Caution For maintenance of fuel cells, refer to paragraph 4-221 on handling the aft fuselage cell.

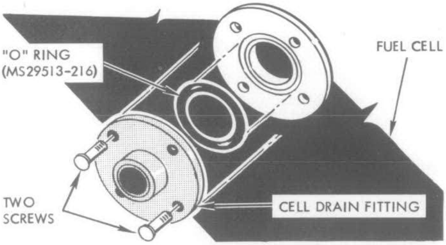
Note Torque all one-quarter 28NF-3 bolts from 50 to 75 inch-pounds.

1 Attach dive vent fitting to cell with two screws (heads turned down to fit through holes in fuel shelf but large enough to retain dive vent fitting).



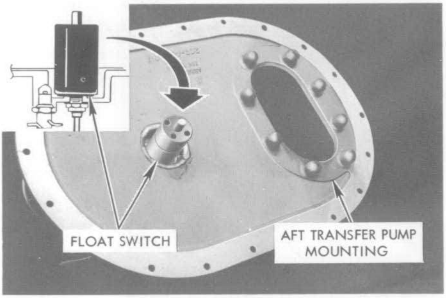
2 Attach cell drain fitting to cell with two screws (heads turned down to fit through sump drain bracket).

FJ-4B-2-48-84

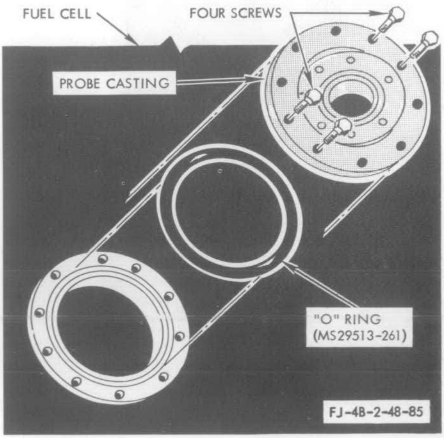


3 Install float switch to access door.

4 If not previously installed, install "O" ring and cell access door to bottom of fuel cell.



5 Attach probe casting (one each side of cell) with four bolts only (remainder to be installed later).

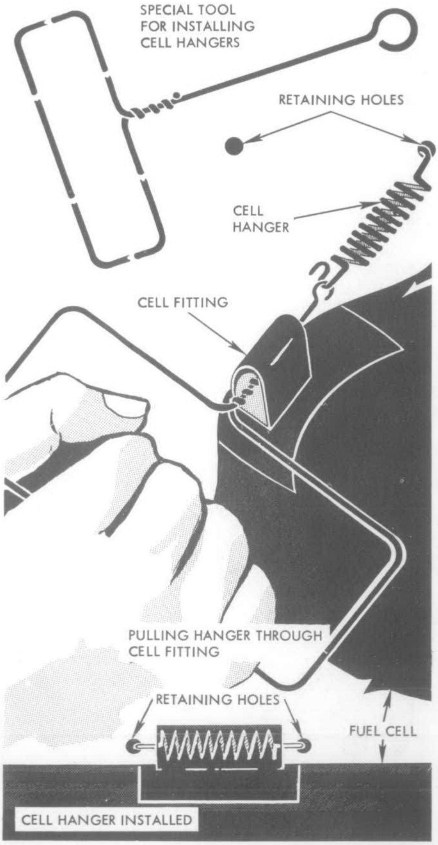


6 Immediately prior to installing fuel cell into fuel cell bay, inspect cell bay area to see that all bits of safety wire, washers, tools and all foreign matter are removed. If anti-chafing tape or fuel cell liners are damaged, replace per paragraph 4-229. Mark cell hanger holes on fuselage liner with light colored grease pencil to aid in installing hangers.

7 Carefully install cell into fuel cell bay.

8 Install cell hangers, working from the aft end of cell forward. Fabricate special tool (made from coat hangers) to aid in installation.

Caution Be sure all hangers are secure in retaining holes.

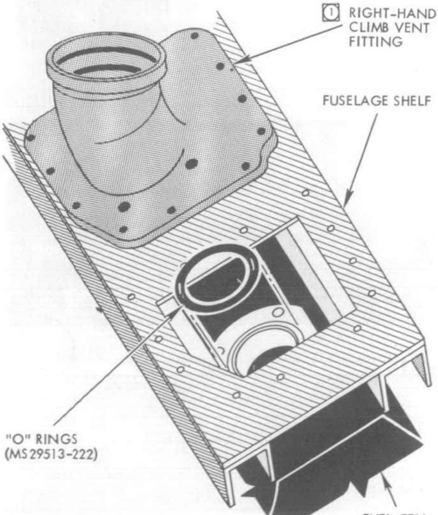


9 Install dive vent fitting to fuselage shelf using MS29513-231 "O" ring. Remove two fabricated screws after fitting is secure and install remainder of bolts. Connect dive vent line.



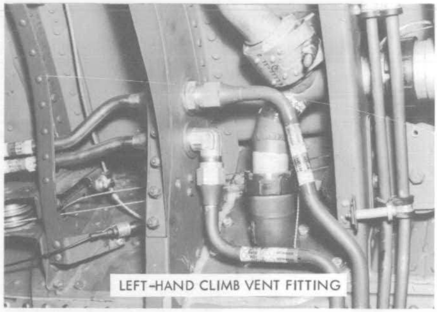
10 Install climb vent fittings (left- and right-hand sides).

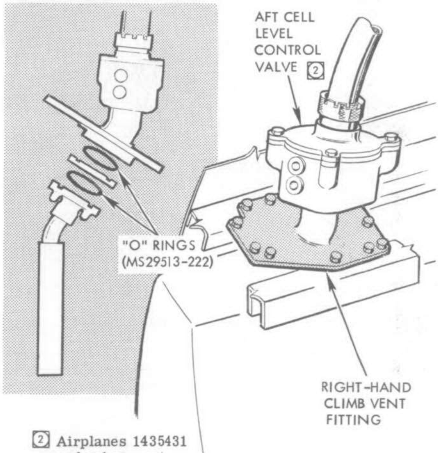
A. Connect climb vent line to climb vent fitting.



① Airplanes 139531i through 143542k

FJ-4B-2-48-87

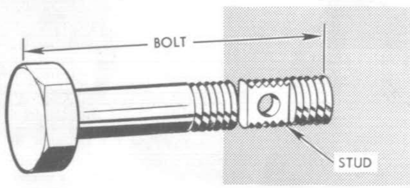




② Airplanes 1435431 and subsequent

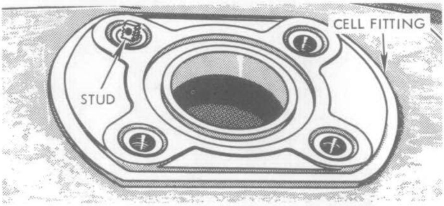
Note Alternate method of installing cell without removing cell fittings.

A. Fabricate stud.

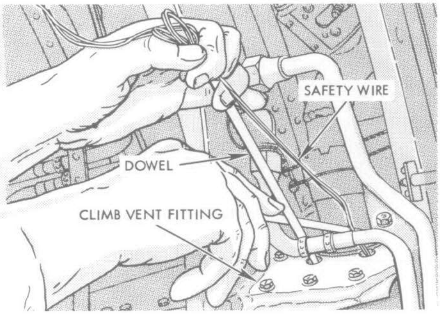


B. Install stud in cell fitting. (Do not tighten.)

FJ-4B-2-48-88



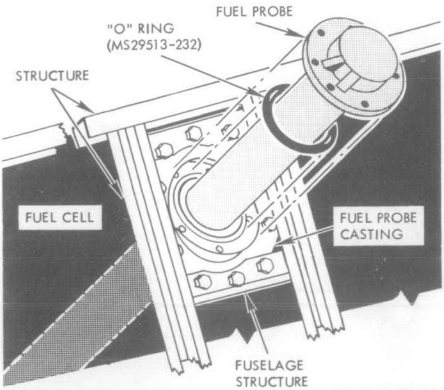
C. Loop heavy safety wire through stud. Pull cell fitting in place and align fuselage attaching holes with dowel.



D. Install bolts. Remove stud and safety wire.

11 Complete fuel probe casting installation (left- and right-hand sides) by bolting casting to aft fuselage structure.

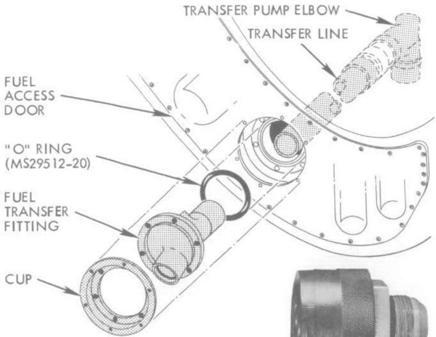
A. Install fuel probes (one on each side) and fuel probe access covers.



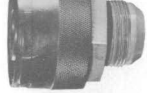
FJ-4B-2-48-169

12 Install "O" ring (180-948040) in "O" ring groove and install fuel cell access door. (See figure 1-9 for sealing instructions.)

13 Connect transfer pump elbow and fuel transfer line fitting to fuel transfer line. Install fuel transfer line assembly to cell with cup positioned over fitting.



14 Install transfer quick-disconnect coupling and torque to 20 foot-pounds. Safety with AN995F32 lock-wires.



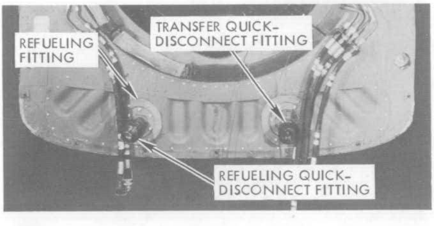
TRANSFER QUICK-DISCONNECT FITTING

15 Install refueling fitting to cell with cup and "O" ring (MS29512-24).

16 Install refueling quick-disconnect coupling and torque to 30 foot-pounds.



REFUELING QUICK-DISCONNECT FITTING



17 Install cell drain fitting to sump drain bracket. Remove the two fabricated screws (step 2) after fitting is secure and install remainder of bolts.

18 Install aft fuselage. (See figure 5-6.)

19 Install aft transfer pump. (Refer to paragraph 4-168.)

20 Perform pressure check of the aft fuselage. (Refer to paragraph 4-158.)

FJ-4B-2-48-163A

4-232. INTEGRAL WING FUEL TANKS.

4-233. The integral wing fuel tanks extend from the inboard end of the wing outboard to the wing fold and extend between the forward and aft spar. The fuel tanks consist of three separate sections in each wing with flapper-type valves to separate the different sections for slosh prevention during violent maneuvers. The perimeter of the tanks is sealed by use of a nonhardening sealant injected into a groove, machined in one structural member along faying surfaces. Attachment screw holes are sealed by "O" rings and protruding head bolts are sealed by Stat-O-Seal washers.

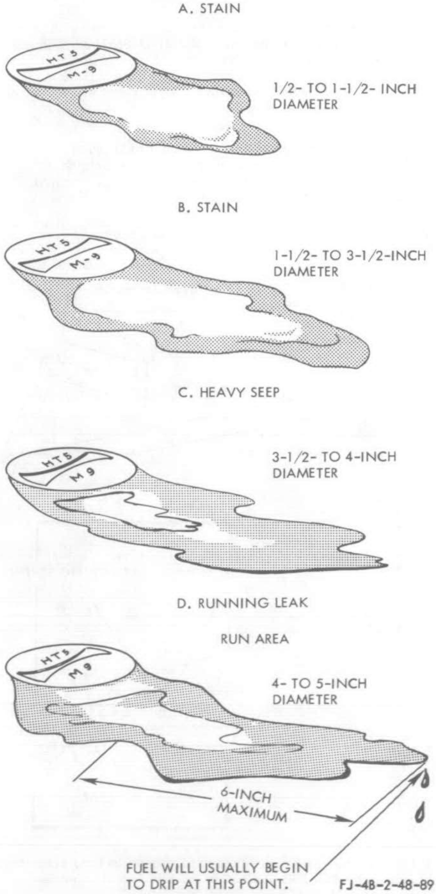
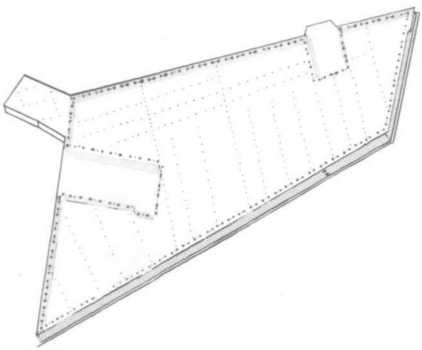


Figure No. 4-67. Integral Wing Leakage Classification Chart

4-234. SEALING INTEGRAL WING FUEL TANK.



To reseal the integral wing fuel tanks, two types of repair are recommended: retorquing and resealing. Retorque screws and bolts, reseal the injection groove around the perimeter of the wing and replace "O" rings and Stat-O-Seal washers. Always retorque to stop a fuel stain or seepage before attempting to seal.

1 RETORQUING

The first step in stopping a leak is to retorque the bolt or screw for 6 inches on each side of the leaking area according to the following chart. The airplane may be on jacks or resting on the landing gear when this torquing is performed as location should have little or no effect on the torque values.

ALL HIGH-STRENGTH BOLTS AND SCREWS
(TORQUE FROM HEAD SIDE)

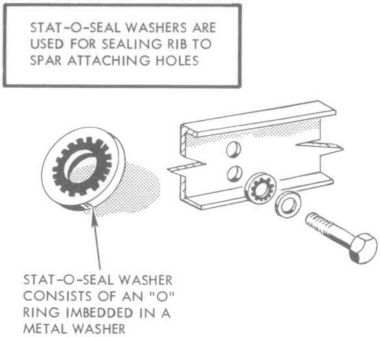
BOLT SIZE (INCHES)	TORQUE (±5%) (INCH-POUNDS)
1/4	85
5/16	190
3/8	335
7/16	715
1/2	940

Standard bolts are used primarily in attaching wing skin. Torque all standard bolts from nut side according to AN Standard Torque Table. If the leak still persists, use the second method of sealing as follows:

FJ-4B-2-48-90

2 REPLACING STAT-O-SEALS

If the leak is at a Stat-O-Seal, replace seal with a new one. Be sure to install washer between the bolthead and Stat-O-Seal or leakage will still persist. Also, be sure to torque bolts according to torque table.



3 REPLACING "O" RINGS

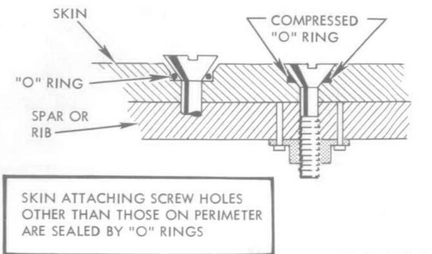
If the leak is at an "O" ring seal, replace "O" ring as follows:

A. Loosen the bolt with a steady pressure.

B. Back out the bolt only as far as necessary to remove the "O" ring.

C. Slip the replacement "O" ring over the head of the bolt, using petrolatum (vaseline) is desired.

D. Torque the bolt to the required torque values listed in the chart in step 1. The bolt should not be completely removed because of the possibility of cross-threading during reinstallation. Cross-threading could result in the loss of a structural fastener by stripped threads or by the threads locking and twisting off the nut plate.



FJ-4B-2-48-91

4 REPLACING FASTENERS

If "O" ring sealed or Stat-O-Seal sealed fasteners (bolts and screws) are found to be marred, cracked, etc, a replacement bolt must be installed as follows:

A. Remove fastener.

Note Be sure the new fastener is identical to the one removed. Standard shank lengths exhibit a large variation in tolerance.

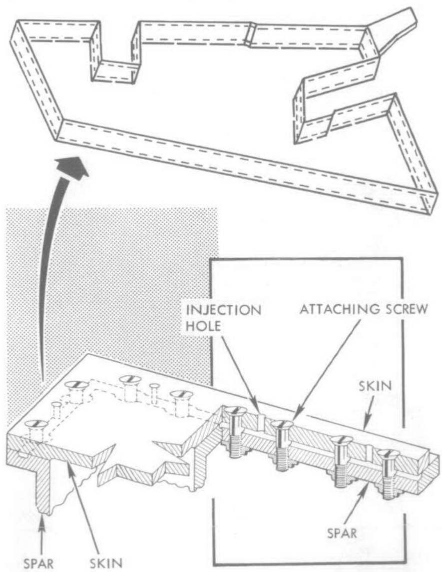
Caution Never replace a fastener except with an identical replacement.

B. Place "O" rings or Stat-O-Seal washers (with proper washer on either side of Stat-O-Seal) on fastener and replace in fastener hole.

C. Torque fastener to proper torque value according to chart listed in step 1.

Note When any access panel or plate has been removed from the integral wing fuel tank, an obstruction and pressure check must be performed. (Refer to paragraph 4-158.)

5 RESEALING THE HORIZONTAL INJECTION GROOVE.



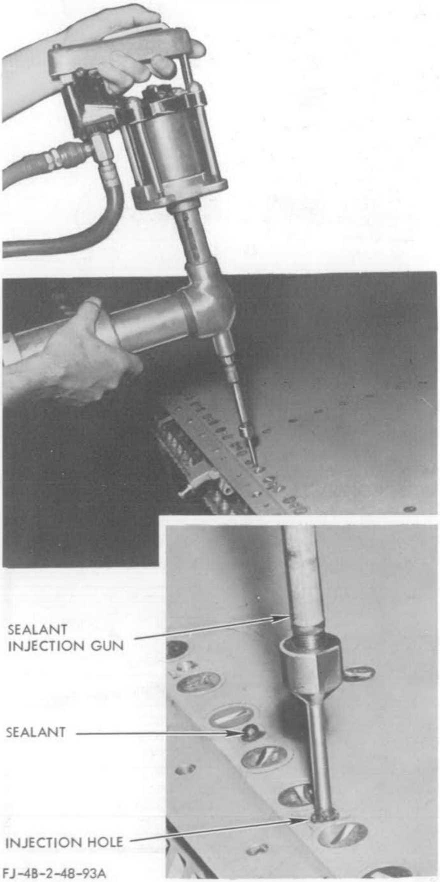
If the fuel leak is at the horizontal groove in the perimeter of the wing, reinject sealant in the horizontal injection groove as follows:

FJ-4B-2-48-92A

A. Using integral fuel tank groove injection compound (item 31, materials list), fill No. 223 groove sealant injection gun (Grover Smith Pump Co.) and provide 90 psi air pressure at inlet in gun.

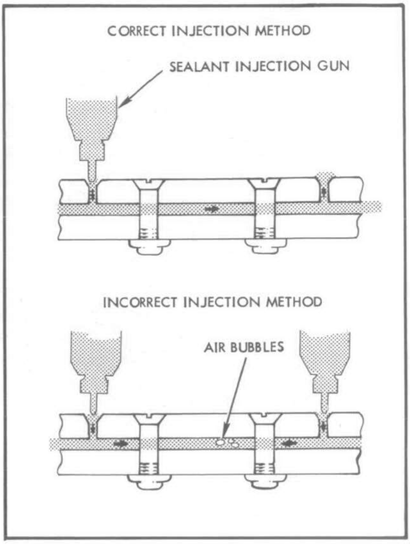
Caution The ability of the sealing compound to seal depends upon its adhesion to metal. Oils and greases are adhesion breakers and must be completely removed from all sealing areas, injection tools and mechanics' hands when operating or servicing the injection gun.

B. Remove screws from injection holes of area to be sealed and place sealant gun nozzle tip into the countersink of the injection hole.



FJ-4B-2-48-93A

Caution It is essential that the groove between the injection holes be filled from one direction only. If the sealant is injected from two directions, an air bubble may be formed midway between the injection holes and a fuel leak will result.



C. Hold the gun firmly in position and depress the trigger until compound of at least one inch in length flows out of the next adjacent injection screw hole. (The trigger must be released approximately every 30 seconds to allow the gun piston to return before another cycle can begin.)

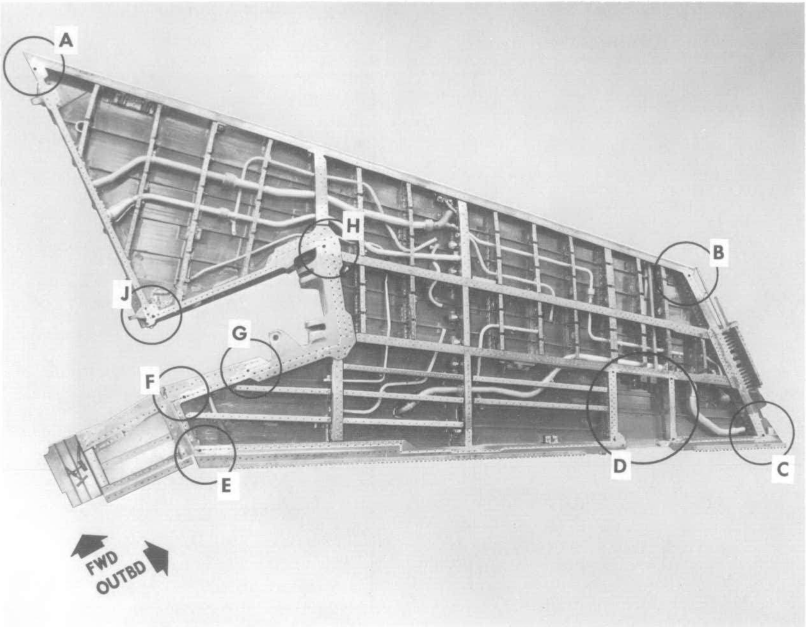
D. Replace the screw in the hole which has just been injected. Proceed in the same manner as in steps A through C on the next adjacent hole (the one from which sealant has protruded), etc, until the area to be resealed is completed.

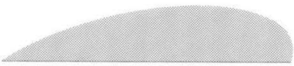
E. After all injection hole screws have been installed, remove excess sealing compound from the wing by scraping with a wood or plastic blade. The area then may be cleaned with solvent (item 119, materials list).

Caution Do not use toluene for cleaning on any surface with a corrosion or fuel resistant coating.

FJ-4B-2-48-165A

6 RESEALING THE VERTICAL INJECTION GROOVE





(Top RH wing with the skin removed for clarity)

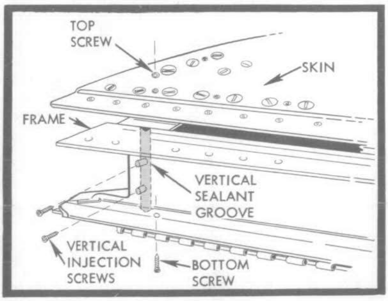


The view shown above is provided to clarify the locations of the actual vertical sealing grooves. The circled areas above can be compared with the circled areas on the wing skin on opposite page to further aid in determining the exact location of the grooves.

The illustration at right portrays a typical vertical sealing groove. Note the injection screws on the vertical plane.

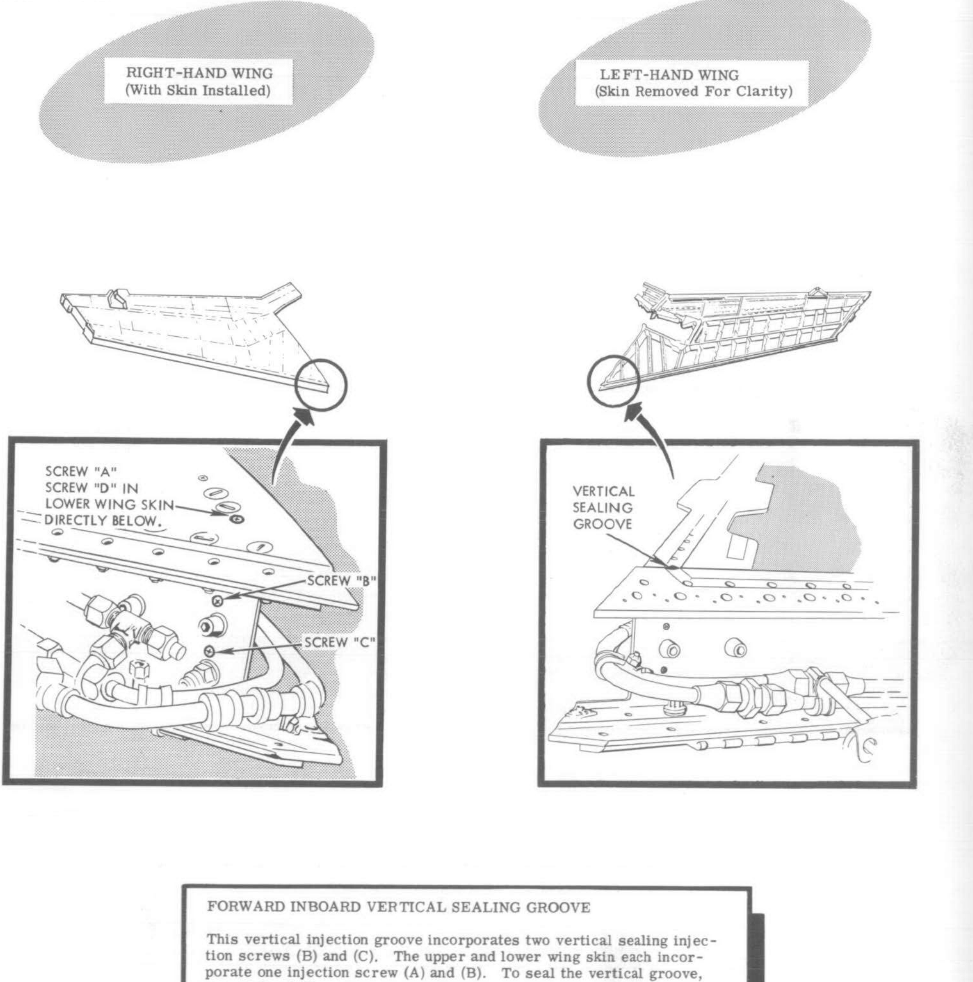
The wing skins are jig drilled. The grooves and the sealant injection screws are exactly the same on both wings. The correct injection screw can be located by comparing the drawings with the actual wings.

TYPICAL VERTICAL SEALING GROOVE



FJ-4B-2-48-94A

DETAIL - A



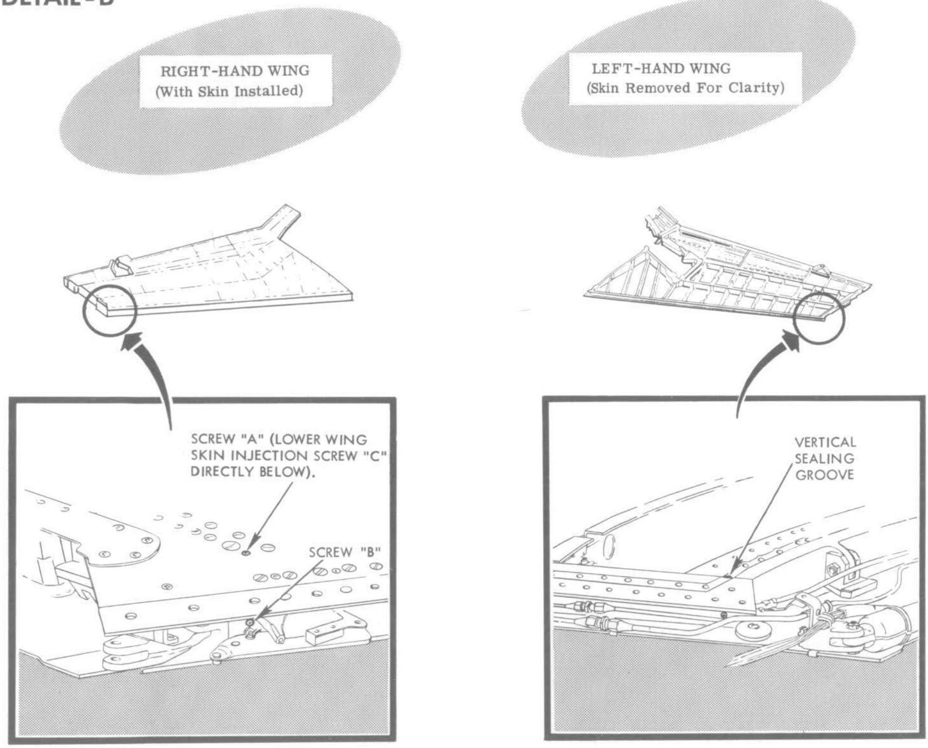
FORWARD INBOARD VERTICAL SEALING GROOVE

This vertical injection groove incorporates two vertical sealing injection screws (B) and (C). The upper and lower wing skin each incorporate one injection screw (A) and (B). To seal the vertical groove, proceed as follows:

> Remove screws (A), (B), (C) and (D). Inject sealant through (A) until it comes out (B). Install screw (A). Inject sealant through (D) until it comes out (C). Install screw (D). Inject sealant through (B) until it comes out (C). Install screws (B) and (C).

FJ-4B-2-48-96A

DETAIL - B



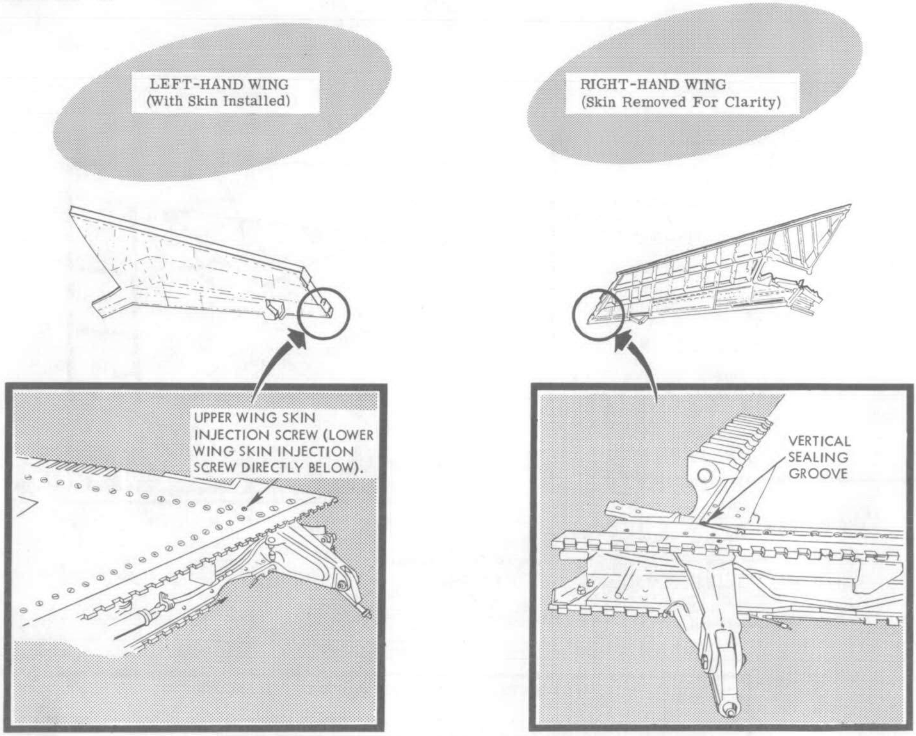
INBOARD WING FORWARD OUTBOARD LEADING EDGE SEALING GROOVE

This vertical sealing groove incorporates one vertical sealing injection screw (B). The upper and lower wing skins each contain an injection screw (A and C). The upper wing skin injection screw is shown; the lower wing skin injection screw is located directly below it. To seal the vertical groove, proceed as follows:

> Remove screws (A), (B) and (C). Inject sealant through (A) until it comes out (B). Install screw (A). Inject sealant through (C) until it comes out (B). Install screws (B) and (C).

FJ-4B-2-48-196

DETAIL - C



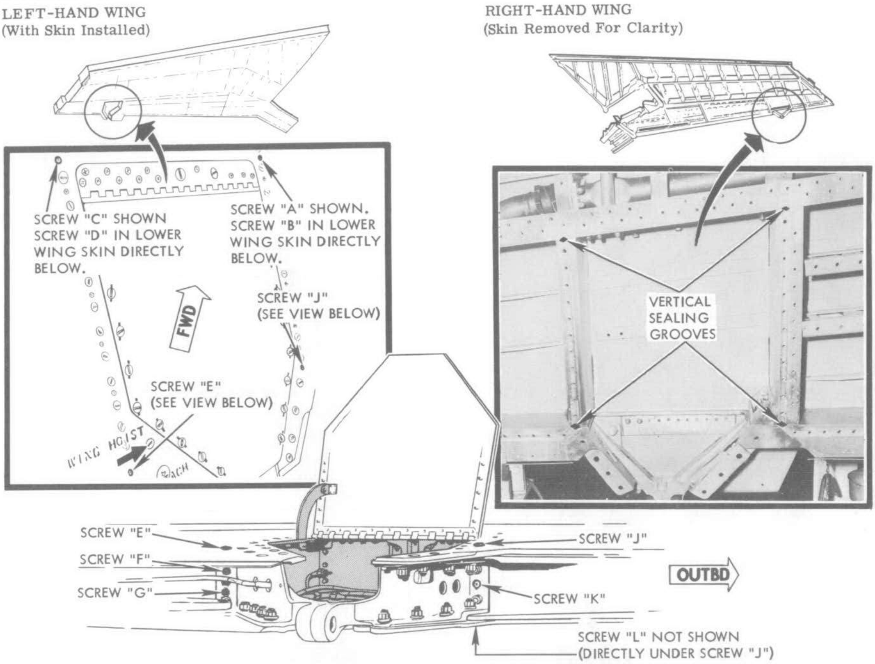
INBOARD WING AFT OUTBOARD TRAILING EDGE SEALING GROOVE

This vertical sealing groove contains no vertical groove injection screws. One injection screw is located in both the upper and lower wing skin. The upper wing skin injection screw is shown; the lower wing skin injection screw is located directly below it. To seal the vertical groove, proceed as follows:

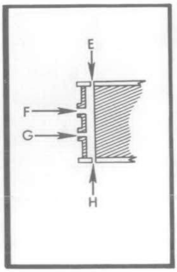
> Remove both the upper and lower wing skin sealant injection screws. Inject sealant through the upper hole until it protrudes from the lower hole. Reinstall the sealant injection screws.

FJ-4B-2-48-197

DETAIL - D



SCREW "H" NOT SHOWN
DIRECTLY UNDER
SCREW "E".



VERTICAL SEALING GROOVES - AILERON ACTUATOR INSTALLATION CUTOUT AREA

Four separate vertical sealing grooves are located in the actuator cutout area. The two forward sealing grooves do not incorporate vertical sealing injection screws. The inboard aft sealing groove incorporates two vertical injection screws. The outboard aft vertical sealing groove incorporates one vertical sealing injection screw. To seal the vertical grooves, proceed as follows:

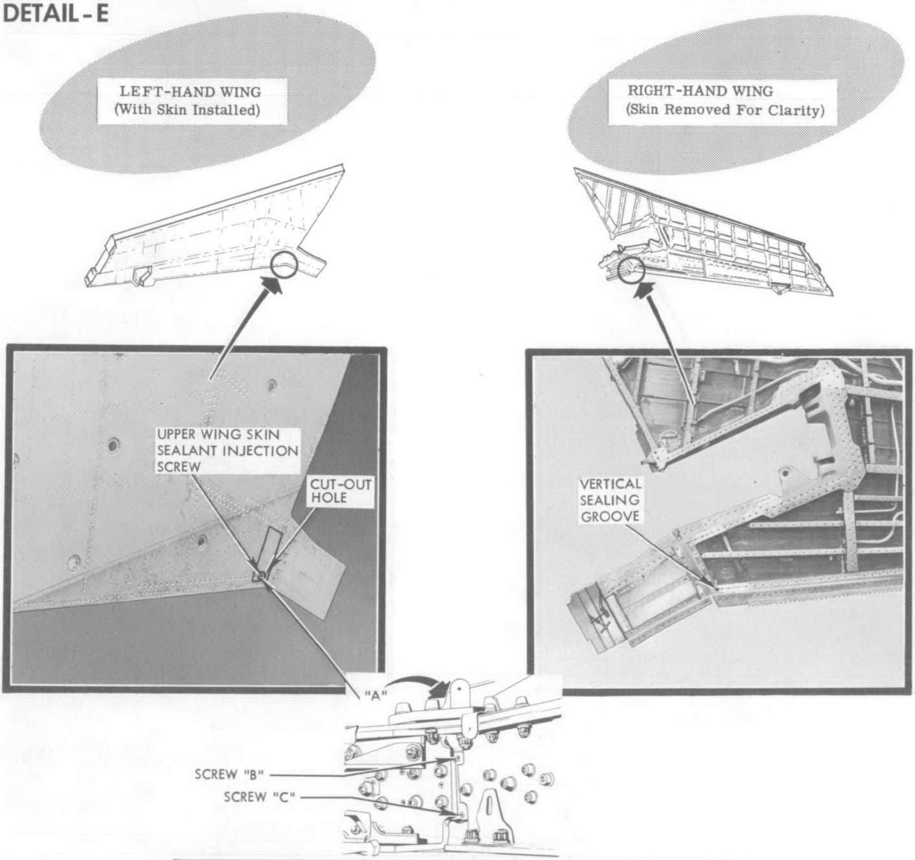
The two forward vertical grooves can be sealed by removing the upper and lower injection screws (A, B, C and D). Seal each groove from top to bottom until sealant comes out the bottom. Reinstall the four screws. To ensure clarity, it should be noted that if sealing of only one forward groove is desired, only the two injection screws for that groove need be removed.

The inboard aft sealing groove can be sealed by removing injection screws (E), (F), (G) and (H). Inject through (E) until sealant comes out (F). Install screw (E). Inject through (H) until sealant comes out (G). Install screw (H). Inject through (F) until sealant comes out (G). Install screws (F) and (G).

The outboard aft sealing groove can be sealed by removing injection screws (J), (K) and (L). Inject through (J) until it comes out (K). Install screw (J). Inject through (L) until it comes out (K). Install screws (K) and (L).

FJ-4B-2-48-198

DETAIL - E



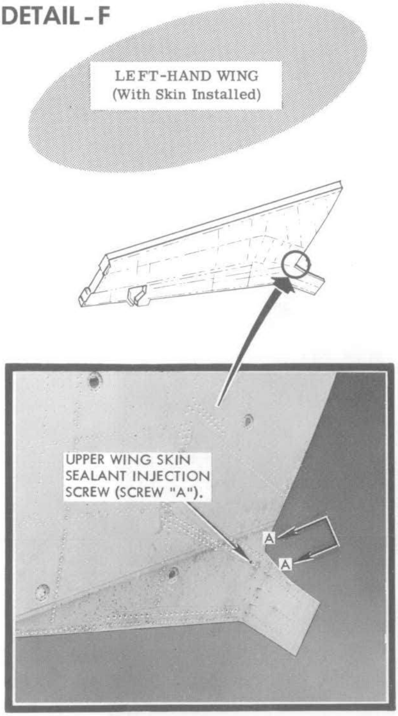
AFT INBOARD VERTICAL SEALING GROOVE

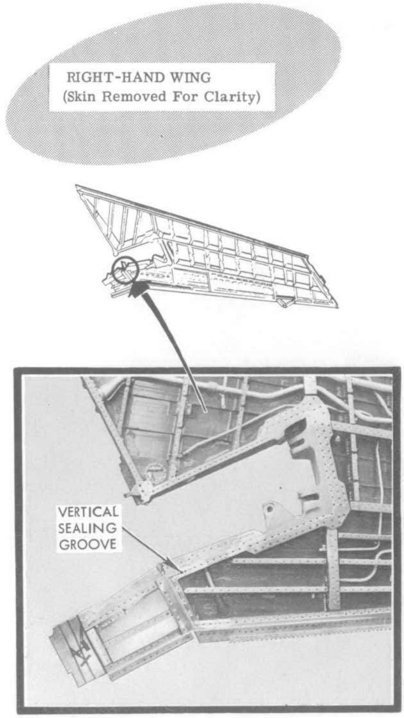
This vertical sealing groove incorporates two vertical sealing injection screws (B and C). The upper and lower wing skin each incorporate one injection screw (A and D). The upper wing skin injection screw is accessible through a cut-out hole in the wing attach fitting. Although not shown, the upper injection screw is indicated on the illustration. The lower wing skin injection screw is located directly below it. To seal the groove, proceed as follows:

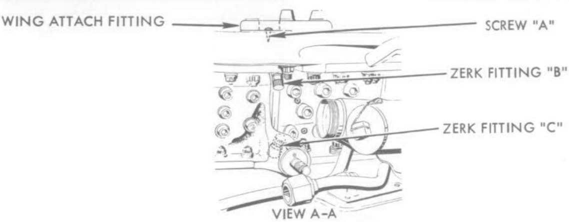
> Remove screws (A), (B), (C) and (D). Inject through (A) until sealant comes out (B). Install screw (A). Inject through (D) until sealant comes out (C). Install screw (D). Inject through (B) until sealant comes out (C). Install screws (B) and (C).

FJ-4B-2-48-199

DETAIL - F







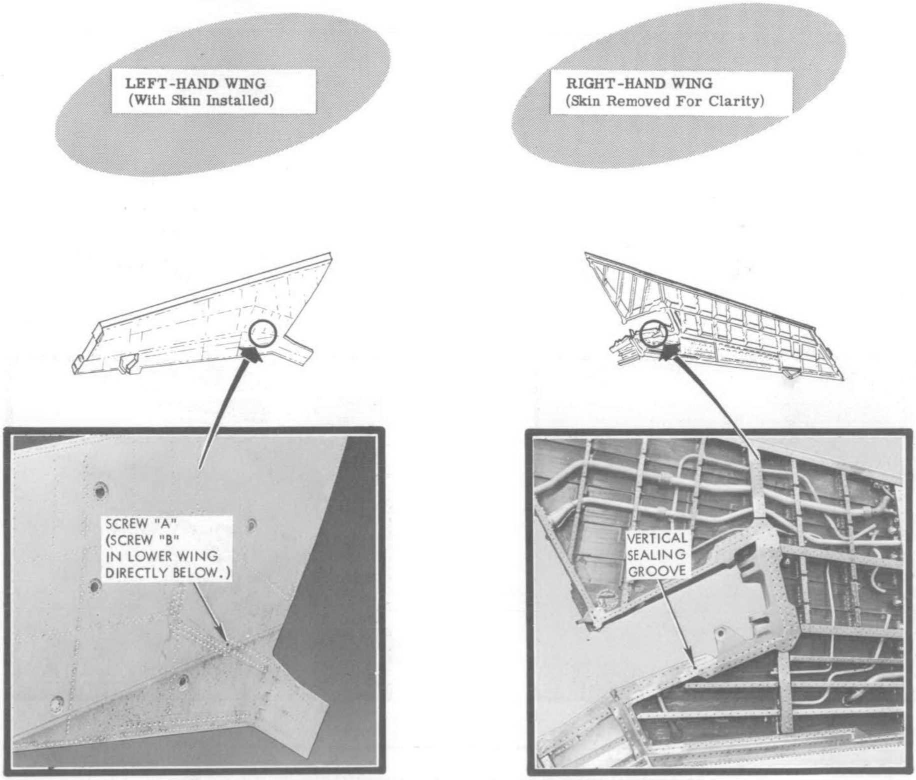
VIEW A-A

Two vertical injection holes are used to seal the vertical groove shown above. Instead of injection screws, two zerk type fittings (B and C) are used. A cut-out hole in the wing attach fitting provides access to the upper wing skin injection screw (A). The lower wing skin injection screw (D) is located directly below screw (A). Inject sealant as follows:

> Remove screws (A) and (D) and caps (B) and (C). Inject sealant through (B) until it comes out (A). Inject through (D) until it comes out (C). Install screws (A) and (D). Inject through (B) until it comes out (C). Install both caps.

FJ-4B-2-48-200

DETAIL - G

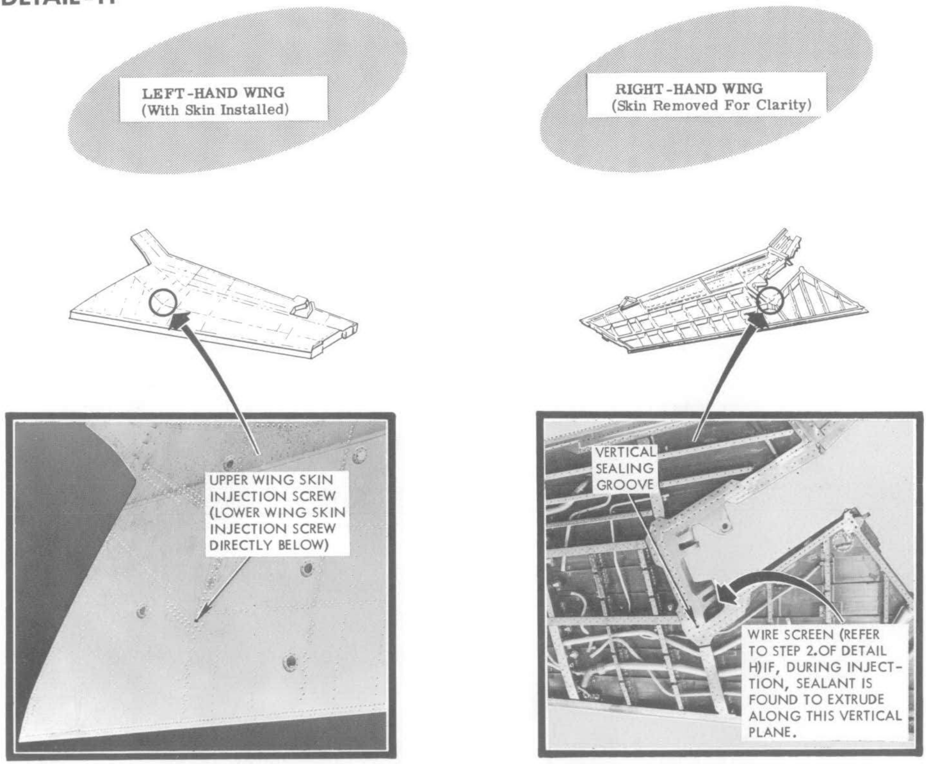


No vertical injection screws are used in this vertical groove. The upper and lower wing skin each incorporate an injection screw. To seal the groove, proceed as follows:

Remove screws (A) and (B). Inject sealant through (A) until it comes out (B). If sealant doesn't protrude at (B), inject through (B) until it comes out at (A).

FJ-4B-2-48-201

DETAIL - H



1. This vertical injection groove does not incorporate any vertical injection screws. To seal groove, remove injection screw from upper and lower skin and inject from top to bottom.

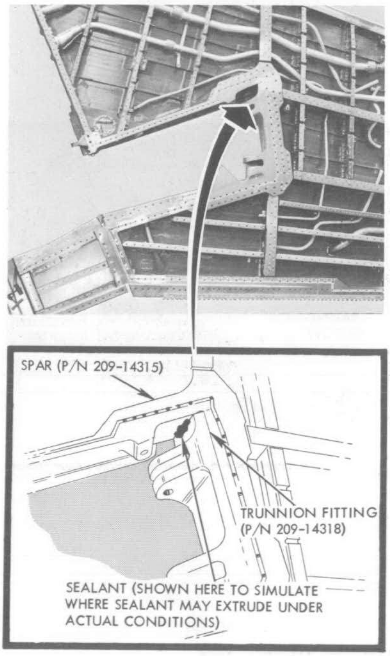
   If sealing compound does not protrude from lower injection hole, repeat the sealing procedure in reverse (inject sealing compound from bottom to top until it protrudes from upper injection hole).

Note In some instances this procedure has required longer than one hour to completely inject the sealing compound through the vertical groove. If sealant is observed to extrude between the faying surfaces (area between upper and lower wing skin) stop injecting immediately and refer to step 2.

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2. Applying wire screen to vertical sealing groove cutout area (if sealant extrudes along vertical plane)

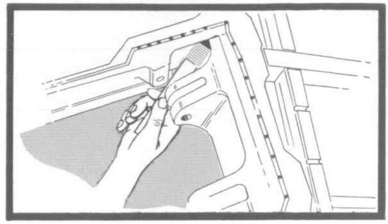
RIGHT-HAND WING
(Skin Removed For Clarity)



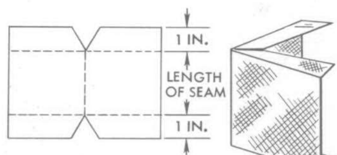
To apply wire screen, proceed as follows:

a. Clean off ALL injection sealing compound that was extruded between the spar (P/N 209-14315) and the trunnion fitting (P/N 209-14318) and clean this area thoroughly with solvent to remove all grease, oil and other foreign matter.

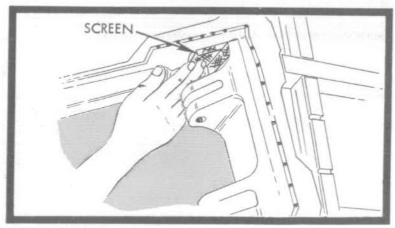
b. With a spatula, apply sealant (Specification MIL-S-7502) to the vertical seam between the spar and the trunnion fitting.



c. Measure the length of the vertical seam. Obtain a piece of regular aluminum screen wire the length of the seam plus 2 inches. Cut and bend the screen to fit the seam as shown below.



d. Fit the screen wire into the sealant. This will provide a reinforcement to hold the sealant firm.

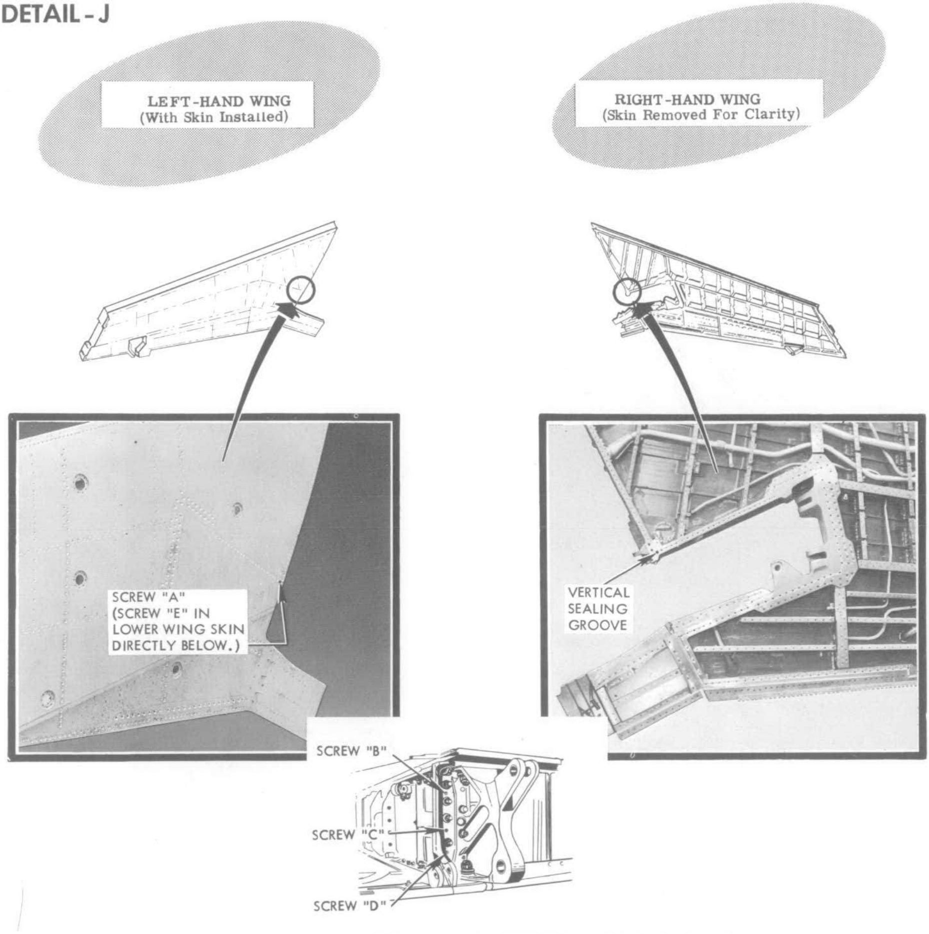


e. Overcoat the screen with more sealant (Specification MIL-S-7502).

f. Cure for 48 hours at 75°F, then repeat reinjection as specified in detail H, step 1.

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DETAIL - J

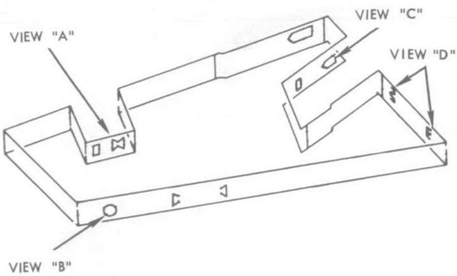


This vertical injection groove incorporates three vertical injection screws (B), (C) and (D). The upper and lower wing skin each incorporate one injection screw (A) and (E). To seal the vertical groove, proceed as follows:

> Remove screws (A) and (B). Inject through (A) until sealant comes out at (B). Install screw (A). Using this step-by-step method, continue until sealant comes out at (E). Install screws (D) and (E).

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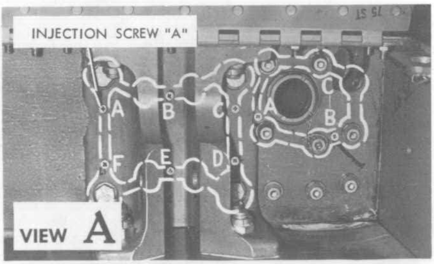
7 RESEALING INTEGRAL WING FITTINGS.

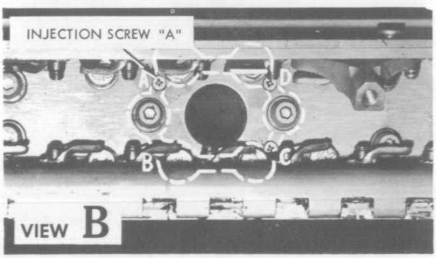


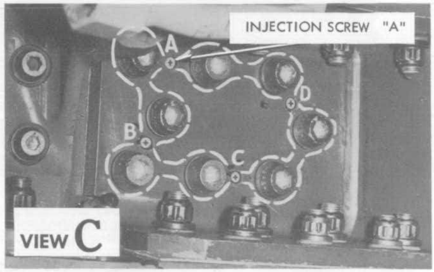
The wing fittings are sealed with the same sealant compound, sealant gun (except for attaching a zerk fitting chuck to the sealant gun nozzle as noted) and procedure as outlined in steps 5A, B, C and E. The methods of injecting sealant compound in the wing fitting areas are as follows:

A. Injection Screw Method.

Remove injection screws (A) and (B). Inject sealing compound at Point (A) until sealant compound protrudes from point (B). Replace screw at point (A) and remove screw at point (C). Inject sealant compound at point (B) until the compound protrudes from point (C). Continue this procedure until all points have been resealed.

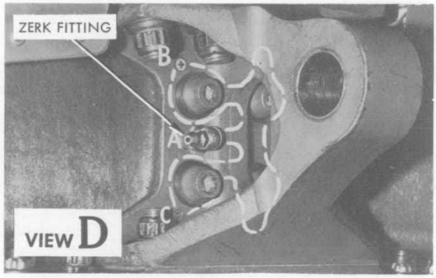






B. Zerk Fitting Injection Method.

Remove screws (B) and (C). Inject sealant compound at point (A) (zerk fitting) until sealant compound protrudes from points (B) and (C).



8 RESEALING INJECTION GROOVES (IF SEALANT IS SLOW TO INJECT)

If sealant is exceptionally slow to inject, the tank may be heated to 43°C (110°F). Heating can be accomplished by the use of electric blankets.

Caution Do not heat the tank in excess of 43°C (110°F) for sealing of the injection groove.

The proper temperatures for ideal sealing conditions are 26°C to 29°C (79°F to 84°F). If the tank is exposed to temperatures below 10°C (50°F), the tank must be heated in excess of 21°C (70°F) before sealing is attempted. This may be accomplished in a heated hangar or by using portable heating units or electric blankets.

Caution Do not attempt to seal the injection groove of the integral fuel tanks if the wing temperature is below 10°C (50°F).

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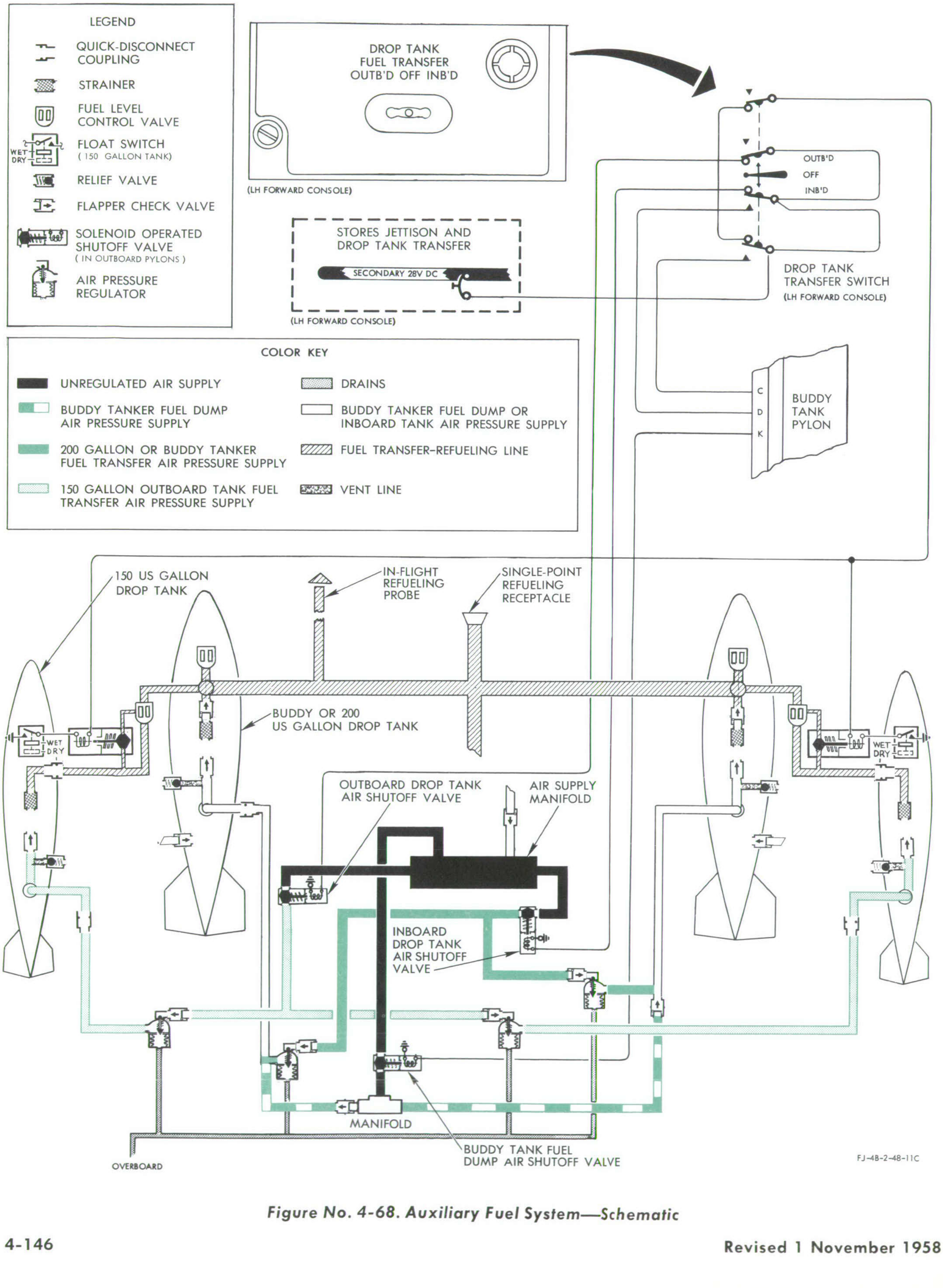


Figure No. 4-68. Auxiliary Fuel System—Schematic

AUXILIARY FUEL SYSTEM

4-235. AUXILIARY FUEL SYSTEM.

4-236. The auxiliary fuel system (figure 4-68) consists of provisions for the following: two Type II, 200-gallon droppable fuel tanks (paragraph 4-262), one under each wing at the intermediate stores station, two 150-gallon external droppable fuel tanks (paragraph 4-269), one under each wing at the outboard stores station, or two in-flight refueling tanks (buddy tanks) (paragraph 4-291), one under each wing at the intermediate stores station. All of the auxiliary tanks are capable of being refueled by the single-point refueling method and the in-flight refueling method. The provisions incorporated in the airplane to provide for the auxiliary tanks consist of the following: a 2-inch line between the two inboard drop tanks, incorporating a motor-operated gate valve for buddy tanker cross ship fuel transfer; a 1½-inch line from the inboard drop tanks to the single-point refueling manifold for normal auxiliary fuel tank transfer; a 1¼-inch fuel line from the inboard drop tank fuel manifold, left and right wing, to the outboard stores station to provide transfer and refueling of the 150-gallon outboard tanks. A line from the forward booster pump supply line to the drop tank transfer line (internal fuel transfer line), incorporating a motor-operated gate valve, is provided for transfer of internal fuel to the buddy tanks. A solenoid-operated shutoff valve (figure 4-69) and two air pressure regulators, utilizing ⅜-inch diameter lines, provide air pressure for transfer of fuel from the inboard 200-gallon auxiliary tanks and buddy tanks. An additional solenoid-operated shutoff valve is provided, by-passing the air pressure regulators and utilizing ½-inch diameter lines for dumping fuel from the buddy tanks. A separate solenoid-operated shutoff valve (figure 4-69) and two air pressure regulators, utilizing ⅜-inch diameter lines, provide air pressure for fuel transfer from the 150-gallon outboard external fuel tank. Air pressure for all auxiliary fuel tank transfer, buddy tank transfer and dumping is derived from the windshield anti-ice and defrost duct and is routed to a manifold unit (aft side of the forward engine bay bulkhead) where the auxiliary fuel system air pressure supply lines originate. All of the auxiliary tanks may be refueled by the single-point refueling system, the in-flight refueling system or they may be gravity-filled. This refueling is accomplished by use of the airplane's internal single-point refueling system, the transfer lines to the external tanks and the fuel level control valves in the auxiliary tanks (and auxiliary tank pylon). Provisions are also incorporated for the jettisoning of the auxiliary fuel tanks. The various methods used to jettison the different types of tanks are shown in chart form in paragraph 4-258. The auxiliary fuel system also consists of numerous check valves, lines and fittings.

4-237. FUNCTION OF AUXILIARY FUEL SYSTEM.

4-238. The function of the auxiliary fuel system depends upon the type of installation. Three separate types of installations are possible, plus a combination of these types. The types of installations and their functions with the auxiliary fuel system are as follows: function of the auxiliary fuel system incorporating the 200-gallon fuel tanks (paragraph 4-239), function of the auxiliary fuel system incorporating buddy fuel tanks (paragraph 4-241) and function of the auxiliary fuel system incorporating 150-gallon tanks (paragraph 4-243).

4-239. FUNCTION OF AUXILIARY FUEL SYSTEM INCORPORATING 200-GALLON FUEL TANKS.

4-240. Positioning the DROP TANK FUEL TRANSFER switch (located on the left-hand forward console) to "INBD," with the engine operating, de-energizes the normally open solenoid-operated shutoff valve to the open position and pressurizes the 200-gallon auxiliary fuel tanks (figure 4-68). The pressurized air, derived from the anti-ice and defrost system, flows from the shutoff valve through the two air pressure regulators and to the 200-gallon auxiliary fuel tanks. The pressurized air transfers the fuel from the auxiliary tanks through the auxiliary fuel transfer lines and enters the airplane's internal fuel system at the dual level control valve assembly. The dual level control valve will open automatically when the fuel level in the forward fuselage cell recedes to a predetermined level, permitting auxiliary fuel to enter the main fuel system. The dual level control valve will close automatically when the forward fuselage cell is full, stopping the flow of fuel from the auxiliary tanks. This cycle is repeated either until all auxiliary fuel from the 200-gallon drop tanks is transferred to the main fuel system or until the DROP TANK FUEL TRANSFER switch is positioned to "OFF." The 200-gallon tanks may be refueled by the single-point, in-flight refueling method. These methods permit fuel to flow to the drop tanks through the drop tank transfer and refueling lines while fuel is simultaneously filling the internal fuel system. When the drop tanks are full, the fuel level control valve in each drop tank will close, shutting off incoming fuel.

4-241. FUNCTION OF AUXILIARY FUEL SYSTEM INCORPORATING BUDDY FUEL TANKS.

4-242. The function of the buddy tank is identical to that of the 200-gallon auxiliary fuel tanks except that no provisions are provided for jettisoning of the tanks mechanically. (Refer to paragraph 7-142B.) The function of the buddy tank, by use of the buddy tank control panel, is contained in paragraph 4-293.

4-243. FUNCTION OF AUXILIARY FUEL SYSTEM INCORPORATING 150-GALLON FUEL TANKS.

4-244. Positioning the DROP TANK FUEL TRANSFER switch to "OUTBD" de-energizes the normally open solenoid-operated air shutoff valve, allowing the valve to open and admit pressurized air to the 150-gallon outboard auxiliary tanks. This will also de-energize the solenoid-operated shutoff valve in the 150-gallon pylon to the closed position, opening the fuel shutoff valve. The pressurized air transfers the fuel from the outboard tank through the drop tank transfer lines to the airplane's internal fuel system. For the function of the release systems of the 150-gallon tank, refer to paragraph 7-142B. The 150-gallon drop tanks may be refueled by the single-point or in-flight refueling method. These methods permit fuel to flow to the outboard tanks through the drop tank transfer and refueling line while fuel is simultaneously filling the airplane's internal fuel system. On airplanes 141467j and subsequent, a refuel switch is provided in the single-point refueling receptacle well to open the 150-gallon fuel shutoff valve (in the outboard pylon) for ground refueling. When the tanks are full, an internally mounted float switch will close the pylon-mounted, solenoid-operated shutoff valve and, in turn, close the fuel level control valve.

4-245. TROUBLE SHOOTING AUXILIARY FUEL SYSTEM.

AUXILIARY FUEL TANK TRANSFER SYSTEM

TEST EQUIPMENT: D-C voltmeter.

SYSTEM CONDITIONS: Engine operating.
DROP TANK FUEL TRANSFER switch in "OFF" position.
STORES JETTISON & DROP TANK TRANSFER circuit breaker engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
INBOARD DROP TANK FUEL TRANSFERS WHEN DROP TANK FUEL TRANSFER SWITCH IS POSITIONED TO "OFF" (DETERMINED BY A CONTINUED FULL INDICATION OF THE FUEL QUANTITY INDICATOR, APPROXIMATELY 5460 POUNDS).			
Defective inboard drop tank air shutoff valve.	Check test point QTA to ground.	28 volts dc.	Replace defective valve.
		Other than 28 volts dc.	Continue trouble shooting.
Defective DROP TANK FUEL TRANSFER switch.	Check test point QTB to ground.	28 volts dc.	Replace defective wire segment to test point QTA.
		Other than 28 volts dc.	Replace defective switch or attached power wire.
INBOARD DROP TANK FUEL FAILS TO TRANSFER (DETERMINED BY CONTINUED DROP OF TOTAL FUEL INDICATION ON THE FUEL QUANTITY INDICATOR).			
Defective inboard drop tank air shutoff valve or DROP TANK FUEL TRANSFER switch.	Check test point QTB to ground.	Zero volts.	Replace defective valve.
		Other than zero volts.	Replace defective transfer switch.
FUEL FAILS TO TRANSFER FROM AUXILIARY TANK OR TANKS.			
Air pressure shutoff valve closed.	Pressure check auxiliary fuel system (paragraphs 4-264, 4-271 and 4-297).		Replace valve.
Restriction or loose connection in air pressure lines.	Pressure check system.		Tighten loose connections.
Tank dive vent valve stuck open.	Visually check.		Clean or replace.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
FUEL OVERFLOWING FROM OUTBOARD (150-GALLON) AUXILIARY FUEL TANK DURING REFUELING OF AIRPLANE.			
Defective 150-gallon tank float switch or solenoid shutoff valve.	Check between test points QT1 and QT2.	Zero ohms.	Replace defective float switch.
		Other than zero ohms.	Replace defective solenoid shutoff valve.

4-246. AUXILIARY FUEL TANK PRESSURIZING SYSTEMS.

4-247. The auxiliary fuel tank pressurizing systems consist of three separate systems: one system for fuel transfer from the 150-gallon outboard tanks, a system for transfer of fuel from the inboard tanks (200-gallon tanks or buddy tanks) and a system for dumping fuel from the buddy tanks. All three pressurizing systems derive air pressure from an air supply manifold in the upper forward section of the engine compartment. The manifold is supplied by air from the anti-ice and defrost duct, slightly forward of the primary heat exchanger (figure 4-11). See figure 4-69 for location of the drop tank air pressurizing systems.

Note

If there is a loss of electrical power to the transfer system, the inboard and outboard drop tank air shutoff valves would shift to their normally open position. This would permit the auxiliary tanks to be pressurized and the fuel to be transferred to the airplane's internal fuel system.

4-248. 200-GALLON TANK AND BUDDY TANK PRESSURIZING SYSTEM. The 200-gallon tank and buddy tank pressurizing system consists of an electrically operated, air pressure shutoff valve, two air pressure regulators and numerous lines and fittings. When the DROP TANK FUEL TRANSFER switch is positioned to "INBD," the inboard drop tank air solenoid valve is de-energized, opening the valve and allowing air pressure to flow through the air pressure regulators (one for each tank, which reduces the air pressure between 7½ and 9 psi) and through ⅜-inch diameter lines to the inboard 200-gallon drop tanks or the buddy tanks. The air pressure, in turn, transfers the fuel through the drop tank transfer and refueling line to the airplane's internal fuel system.

4-249. 150-GALLON OUTBOARD TANK PRESSURIZING SYSTEM. The 150-gallon outboard tank pressurizing system (figure 4-69) consists of an electrically operated, air pressure shutoff valve, two air pressure regulators and numerous lines and fittings. When the DROP TANK FUEL TRANSFER switch is positioned to "OUTBD," the outboard drop tank air solenoid valve is de-energized, thus opening the valve and allowing air pressure to flow through the air pressure regulators (one for each tank, which reduces the air pressure to between 7½ and 9 psi) and through ⅜-inch diameter lines to the outboard 150-gallon tanks. The air pressure, in turn, transfers the fuel through the drop tank transfer and refueling line to the airplane's internal fuel system.

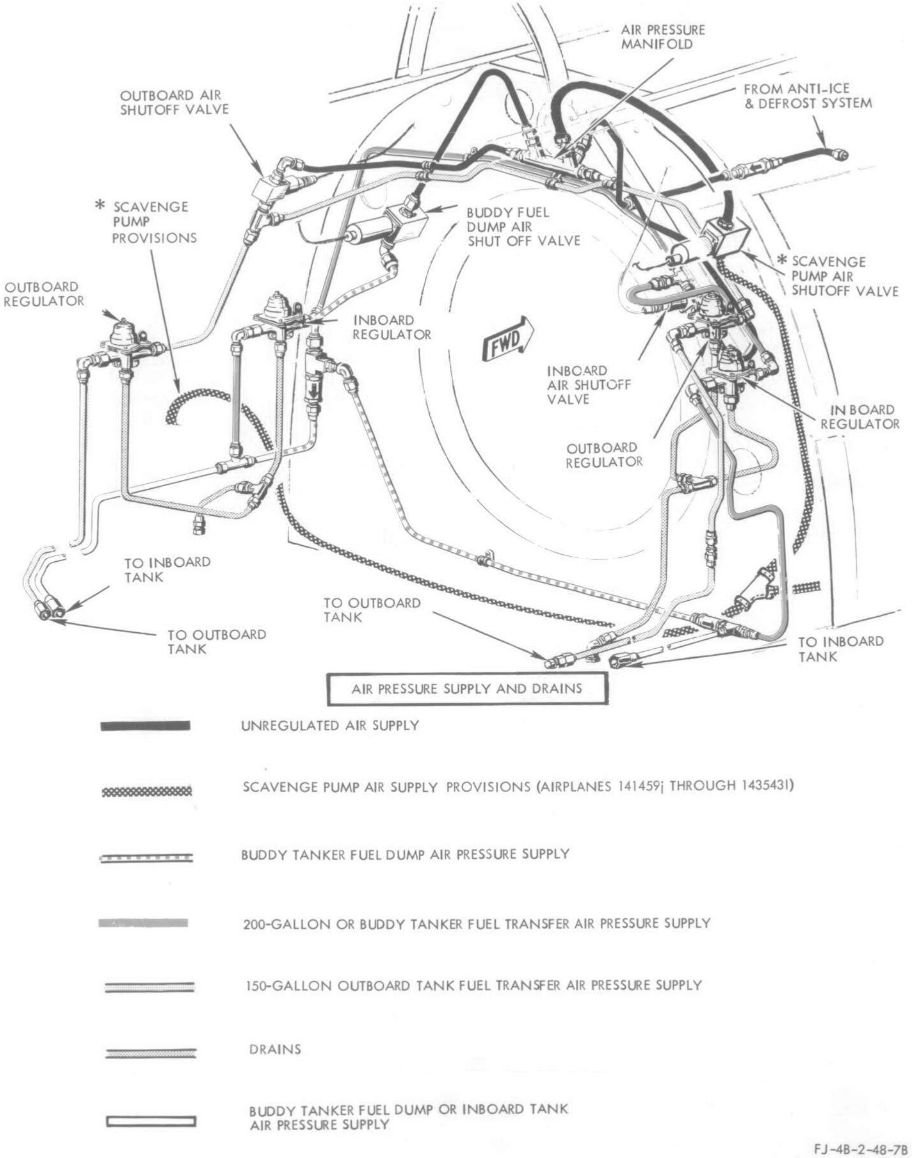


Figure No. 4-69. Auxiliary Fuel Tank Pressurizing Systems

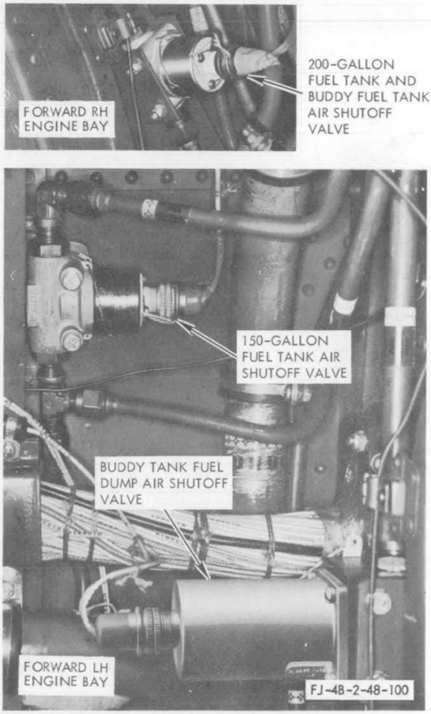


Figure No. 4-70. Auxiliary Fuel System Air Solenoid Valves

4-250. BUDDY TANK FUEL DUMPING SYSTEM. The buddy tank fuel dumping system consists of a solenoid-operated shutoff valve, two fuel dump valves (located in the buddy tanks) and numerous lines and fittings. When the buddy fuel dump switch, located on the buddy tank control panel on the vertical console, is positioned to "DUMP," the solenoid-operated shutoff valve is energized, allowing unregulated air to flow to the buddy tanks through $1/2$-inch diameter lines. Simultaneously, the fuel pumps begin operating (to aid the air pressure) and the fuel dump valves in the buddy tanks are actuated, allowing fuel to dump from the opening near the rear of each buddy tank.

4-251. AUXILIARY FUEL SYSTEM AIR SOLENOID VALVES.

4-252. The auxiliary fuel system air solenoid valves (figure 4-70) are of the poppet type and are actuated by an electrical solenoid. The buddy tank fuel dump air solenoid valve is in the closed position when de-energized. The 150- and 200-gallon drop tank air solenoid valves are in the open position when de-energized. The valves operate on 28 volts dc.

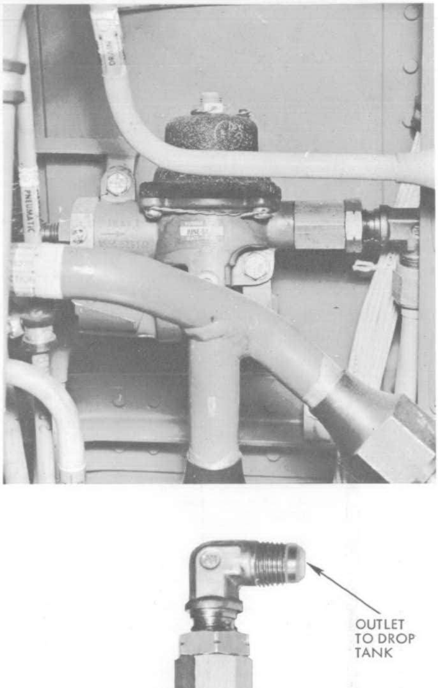


Figure No. 4-71. Auxiliary Fuel System Air Pressure Regulator

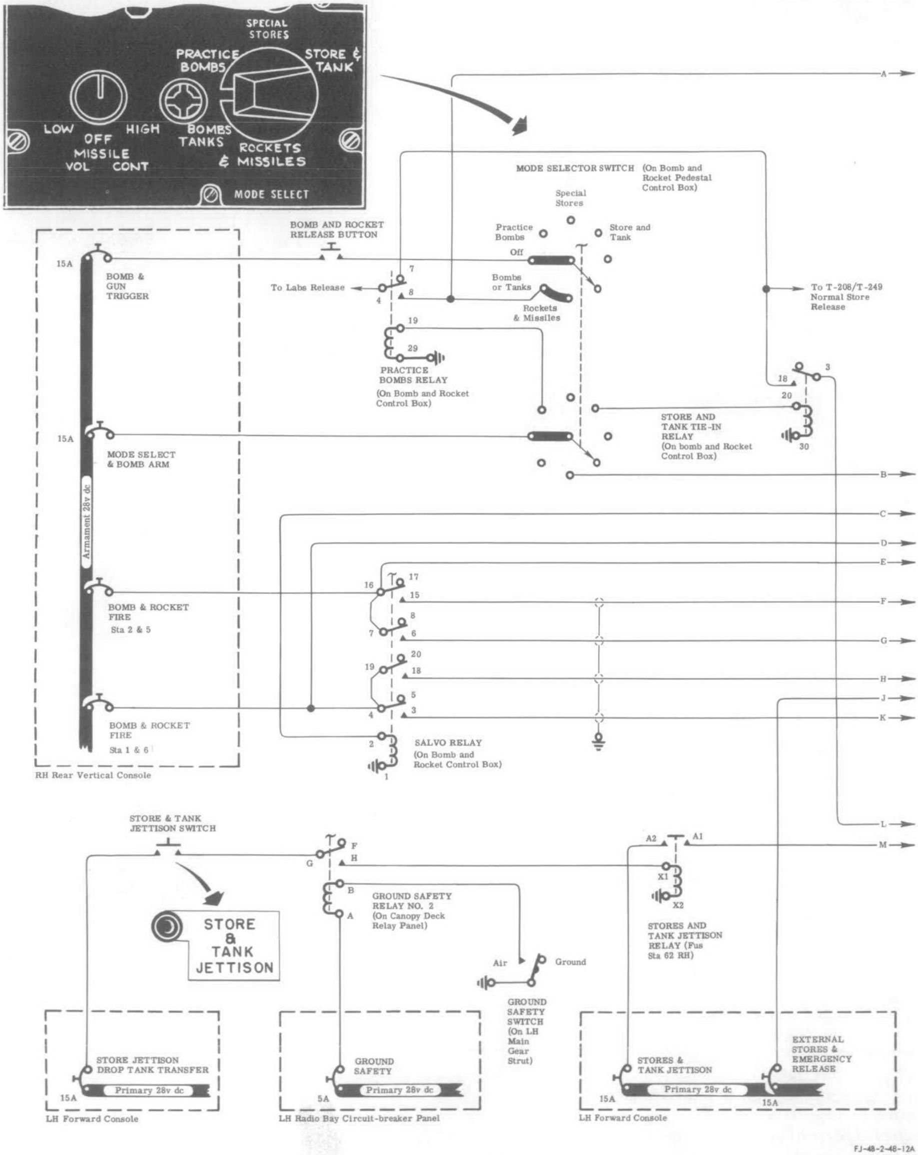


Figure No. 4-72. Auxiliary Fuel Tank Release Systems (Sheet 1)

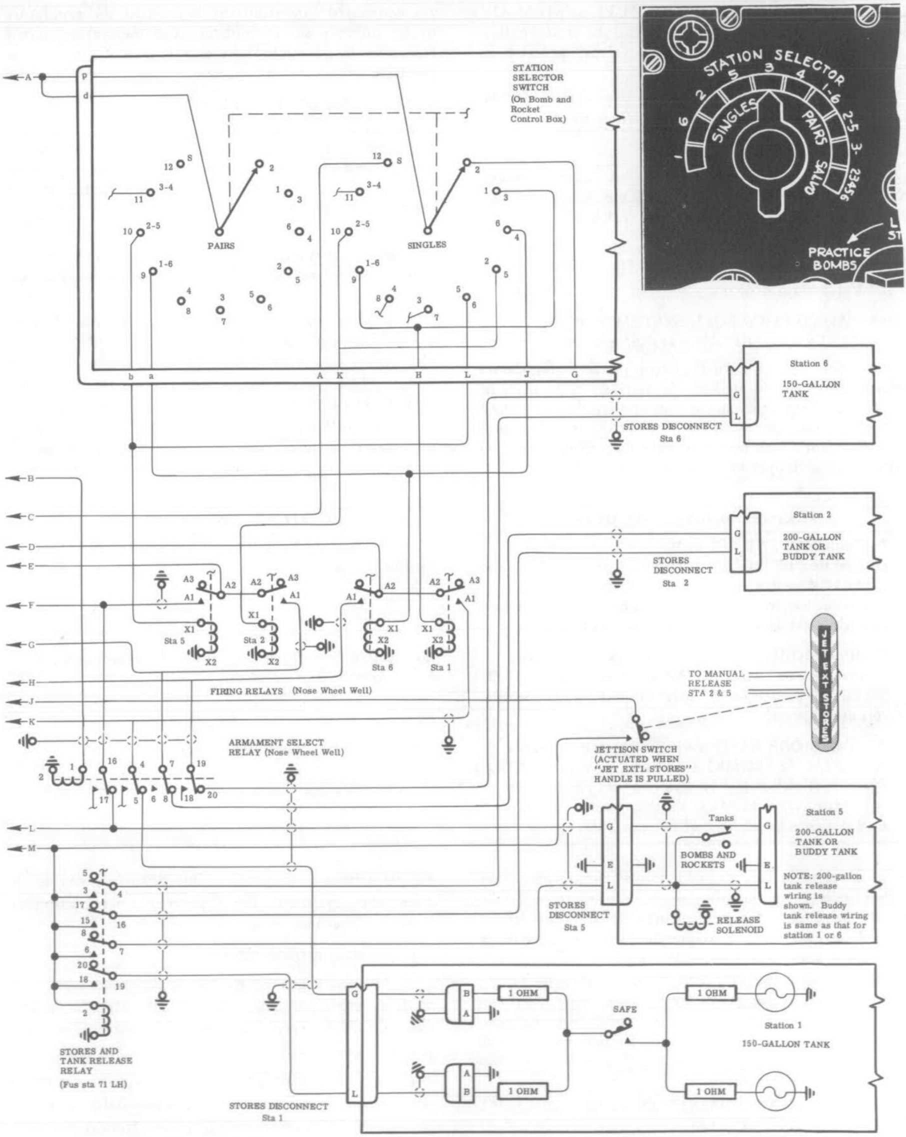


Figure No. 4-72. Auxiliary Fuel Tank Release Systems (Sheet 2)

4-253. CHECKING AUXILIARY FUEL SYSTEM AIR SOLENOID VALVES. To check the 150- or 200-gallon auxiliary fuel tank air solenoid valves, proceed as follows:

a. Apply a 28-volt d-c power source to pin "A" (positive) and a ground to pin "B" (negative).

b. Valve should close.

4-254. CHECKING BUDDY TANK FUEL DUMP AIR SOLENOID VALVE. To check the buddy tank fuel dump air solenoid valve, proceed as follows:

a. Apply a 28-volt d-c power supply to pin "A" (positive) and a ground to pin "B" (negative).

b. Valve should open.

4-255. AUXILIARY FUEL SYSTEM AIR PRESSURE REGULATORS.

4-256. The auxiliary fuel system pressure regulators (figure 4-71) are located on the left and right sides of the forward engine compartment, one regulator for each 150-gallon fuel tank and one for each 200-gallon tank or buddy tank. Each regulator contains a filter screen, an orifice and a flapper-type check valve on the inlet side. An overboard line from the bottom of the regulators drains off by-pass air, moisture and thermal expanded fuel. This line is routed to the underside of the airplane fuselage.

4-257. AUXILIARY FUEL TANK RELEASE SYSTEMS.

4-258. The auxiliary fuel tanks (including the buddy tanker) and all external stores may be jettisoned simultaneously from all underwing stations by either of two methods (figures 4-72 and 4-73):

a. Depressing the STORE & TANK JETTISON button (located above the forward end of the left-hand console) will release electrically all auxiliary tanks and external stores.

b. Pulling the JET EXTL STORES handle (located on the forward end of the left-hand console) releases electrically all auxiliary fuel tanks and external stores and, in addition, will release mechanically the 200-gallon inboard auxiliary tanks.

c. The following methods may be used to jettison auxiliary fuel tanks when it is desired to retain the external stores carried at the other underwing stations.

PROCEDURE TO RELEASE TANK OR TANKS	AUXILIARY FUEL TANK INSTALLATION
Position MODE SELECT switch on external stores control box to "BOMBS & TANKS," position STATION SELECTOR switch to "2," then "5" (to drop tanks individually), or to "2-5" (to drop tanks together) and depress bomb-rocket release button.	**Two 200-gallon, Type II auxiliary fuel tanks or two buddy tanks.**
Position MODE SELECT switch on external stores control box to "BOMBS & TANKS," position STATION SELECTOR switch to "5" and depress bomb-rocket release button.	**One 200-gallon, Type II auxiliary fuel tank at right-hand intermediate station.**
Position MODE SELECT switch on external stores control box to "BOMBS & TANKS," position STATION SELECTOR switch to "1," then "6" (to drop tanks individually), or to "1-6" (to drop tanks together) and depress bomb-rocket release button.	**Two 150-gallon auxiliary fuel tanks.**

d. To remove the 200-gallon tanks (paragraph 4-266) individually from outside the cockpit, insert a 3/8-inch square drive extension wrench into the slot provided on the inboard side of the adapter beam. Turn the wrench counterclockwise and tank will release.

e. To remove the 150-gallon tanks (paragraph 4-278) or buddy tanks (paragraph 4-298) (both are hung on an Aero 7A bomb rack) individually from outside the cockpit, place a socket wrench on the manual release knob (left-hand forward side of rack) and turn counterclockwise and tank will release.

4-259. CHECKING 200-GALLON AUXILIARY FUEL TANK RELEASE SYSTEM.

a. Be sure tanks are completely drained of fuel.

b. Ground safety switch, located on the left main landing gear, must be actuated before auxiliary fuel tanks can be released electrically. This procedure can be accomplished by jacking the airplane or disconnecting the linkage arm at the ground safety switch.

c. Securely ground airplane.

d. Connect a ground wire from the metallic structure of both auxiliary tanks and to the airplane metallic structure. Make sure this wire is of sufficient length to permit connection after tanks have been released.

e. Install spring-loaded fuel tank ejector rig pin in hole at base of both fuel tank ejector shafts. (Refer to paragraph 4-267.) Remove all tension from compression sway braces by turning ball adjustment on outboard sway brace (paragraph 4-268) and positioning down alongside tank to prevent damage from tank falling.

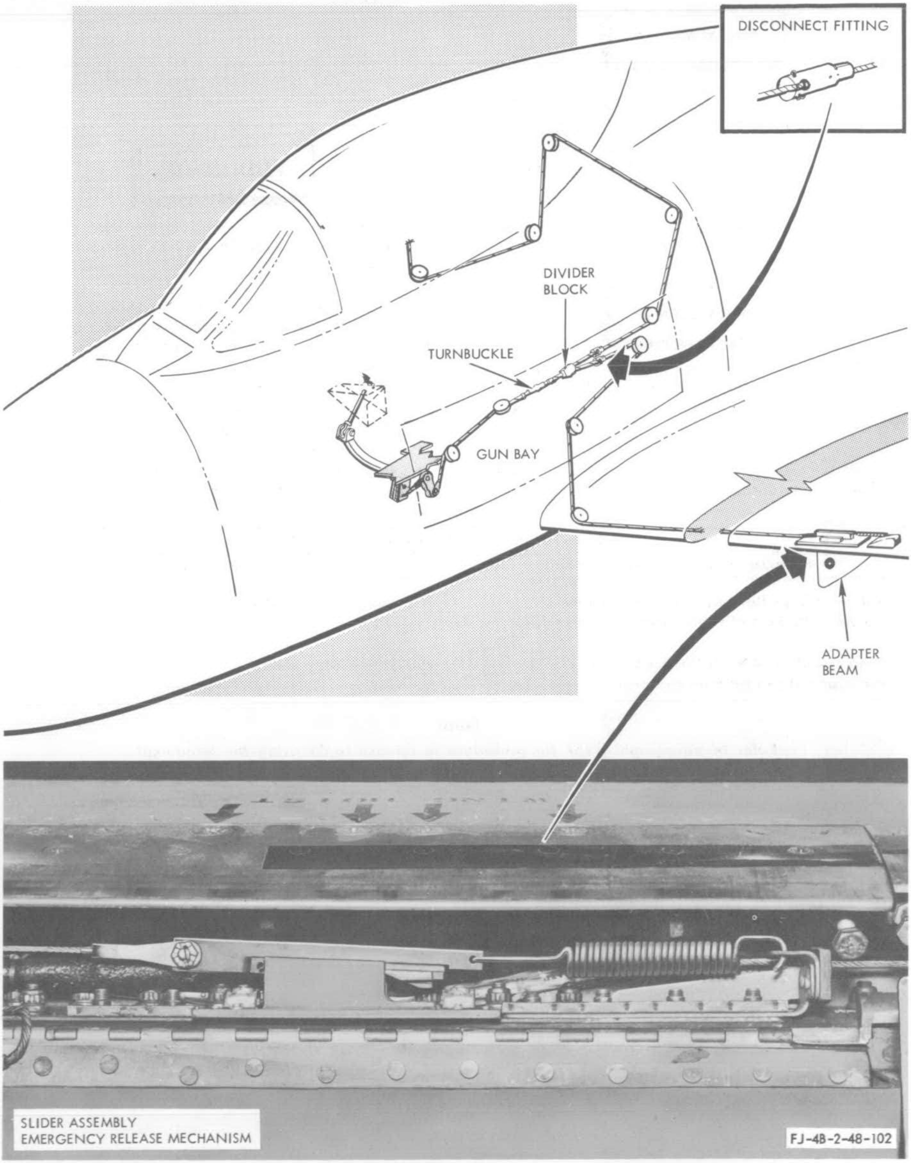


Figure No. 4-73. Auxiliary Fuel Tank Manual Release System—Inboard Tank Station

WARNING

Failure to comply with the preceding procedure may result in damage to the airplane and injury to personnel as each of the fuel tank ejector springs has a tension of 474 pounds. The compression sway-brace springs have a spring-loaded tension of 200 pounds.

f. Position a suitable cradle or stand to catch tanks before they drop more than approximately 2 inches.

WARNING

Make sure that all personnel are well away from the tanks during the drop test. Particularly dangerous areas are ahead of and behind the tanks.

g. Connect an 18-volt external power source to the airplane (except during the manual release test).

Note

An 18-volt external power source is connected to the airplane to make sure that the release system will operate in the event of low voltage on the airplane's electrical system.

WARNING

Place the D.C. POWER switch in the "OFF" position while servicing the airplane with external power.

h. The following chart shows the different methods which can be used to release the 200-gallon drop tanks. The particular ones to check depend on the type of installation in the airplane.

Note

Electrical release should be accomplished within 2 seconds after pressing button or switch. Failure of tanks to release instantly indicates that an inspection of the release system is necessary.

200-GALLON AUXILIARY FUEL TANK RELEASE SYSTEMS

PROCEDURE TO RELEASE TANK OR TANKS	TYPE OF INSTALLATION
Pull handle on left-hand forward console (releases tanks and stores from all stations).	200-gallon drop tanks.
Push STORE & TANK JETTISON button (releases tanks and stores from all stations).	200-gallon drop tanks.

Note

Refer to paragraph 4-257 for procedure to release tanks using the armament system.

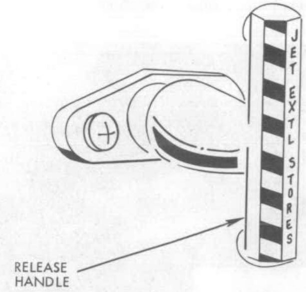
i. Disconnect ground wire from auxiliary tanks; then, disconnect end from airplane metallic structure. This will reduce the chance of a spark at the auxiliary tank.

Note

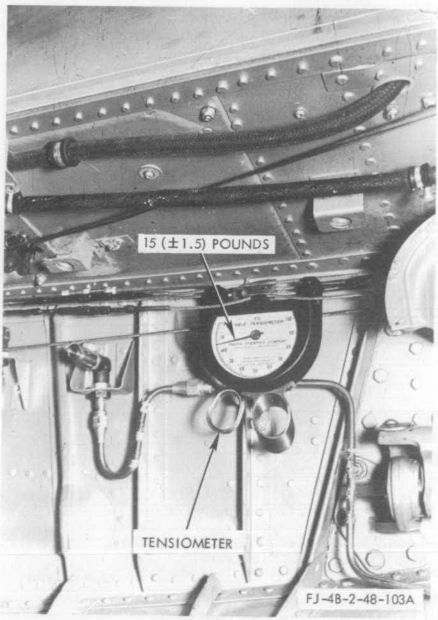
To check the 150-gallon tank or buddy tank release system, a continuity check of the electrical release circuit must be performed. See figure 4-68 for wiring schematic.

4-260. RIGGING AND ADJUSTING AUXILIARY FUEL TANK MANUAL RELEASE SYSTEM — INBOARD TANK STATION.

1 Position JET EXTL STORES handle to full in position.

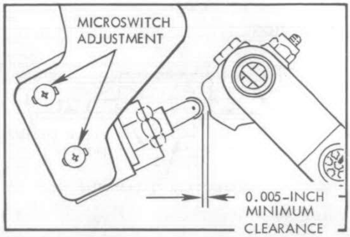


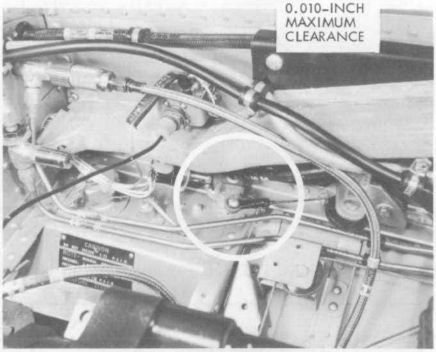
2 With release mechanism spring in the installed (relaxed) position and JET EXTL STORES handle in the full in position, adjust turnbuckle aft of divider block so cable tension will be 15 (±1.5) pounds.



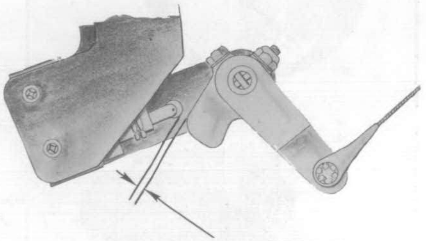
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Adjust microswitch to actuate when JET EXTL STORES handle is pulled. Roller of microswitch button should clear cam but clearance should not exceed 0.010 inch when in the full in position. (1)





Check microswitch cam clearance (0.093 inch minimum, 0.187 inch maximum). Cycle JET EXTL STORES handle and check to see that microswitch actuates. (2)

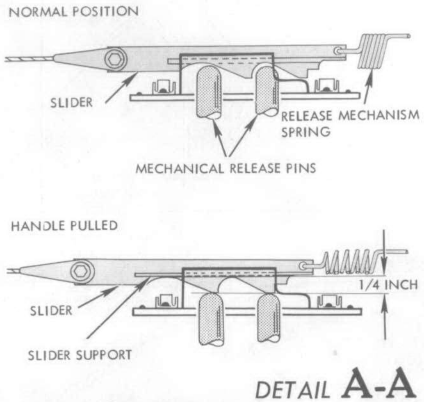


(1) Airplanes 139531i through 141458j

(2) Airplanes 141459j and subsequent

FJ-4B-2-48-104

3 When handle is pulled to full out position with pylon installed, the travel of mechanical release pins should be 1/4 inch.



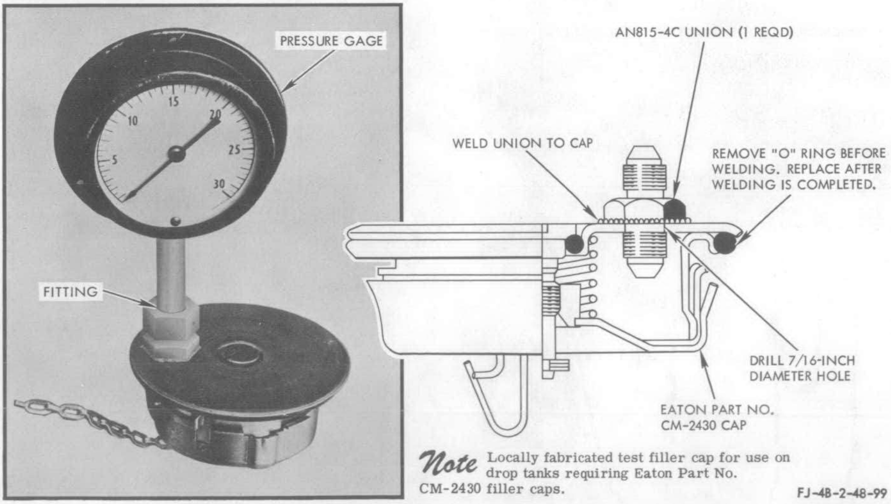
4 Operate several times and re-check above steps.

5 Safety turnbuckles with AN995F41 lockwire.

6 Maximum load on handle to be 25 pounds.



4-261. FILLER CAP FOR PRESSURE CHECKING AUXILIARY FUEL TANKS. The filler cap for testing the auxiliary fuel tanks (figure 4-74) is used with the 200-gallon auxiliary fuel tank (paragraph 4-262) and the 150-gallon fuel tank (paragraph 4-269).



Note Locally fabricated test filler cap for use on drop tanks requiring Eaton Part No. CM-2430 filler caps.

FJ-4B-2-48-99

Figure No. 4-74. Filler Cap for Pressure Checking Auxiliary Fuel Tanks

200-GALLON AUXILIARY FUEL TANKS

4-262. 200-GALLON AUXILIARY FUEL TANKS.

4-263. The 200-gallon, Type II auxiliary fuel tank consists of the following internally mounted equipment (figure 4-75): a fuel level control valve, a vent and relief valve, a fuel filter and numerous check valves, lines and fittings. The equipment in the tank pylon consists of the following: an air and fuel line with pull-away fittings, a forward and aft support post to attach the tank to the adapter beam, an ejector assembly to jettison the tank and a dive vent valve. The tanks are of aluminum alloy construction and are faired and supported by a removable adapter beam (attached to the wing) and dual compression sway braces. One filler cap is located at the top of each tank. Two drain screws and a spring-loaded petcock are located in the bottom of each tank for draining purposes. A fuel strainer, located above a removable retainer plug in the bottom of each tank, incorporates the spring-loaded petcock.

4-264. PRESSURE CHECKING 200-GALLON AUXILIARY FUEL TANKS TRANSFER SYSTEM.

4-265. The auxiliary fuel tanks transfer system may be checked, with the engine in operation, as follows:

a. Fabricate two gravity filler caps (figure 4-74) to incorporate a 0 to 25 psi air pressure gage. This can be accomplished by drilling a hole in the filler cap and either threading the cap for a line fitting or welding a line fitting to the filler cap. Attach the pressure gage to this fitting.

b. Fill auxiliary tanks by use of the gravity filler and be sure main fuel system is at least 200 gallons below capacity.

c. Install special gravity filler cap, which incorporates a 0 to 25 psi pressure gage, on each tank.

d. Disengage AFT FUEL TRANSFER PUMP and WING FUEL TRANSFER PUMP circuit breakers on the left-hand rear console circuit-breaker panel.

e. Start and operate engine at 85 to 95% rpm. (Refer to paragraph 1-9.)

f. Place DROP TANK FUEL TRANSFER switch in the "INBD" position.

g. Pressure gage on each tank filler cap should read 7 to 9 psi.

h. After 2 minutes of operation with DROP TANK FUEL TRANSFER switch in "INBD" position, turn switch to the "OFF" position and shut down engine.

i. Fill auxiliary fuel tanks with fuel. Each drop tank should take at least 35 U. S. gallons of fuel to fill the tank.

j. Replace regular gravity filler caps on each tank.

k. Engage AFT FUEL TRANSFER PUMP and WING FUEL TRANSFER PUMP circuit breakers.

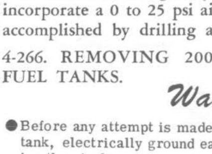
4-266. REMOVING 200-GALLON AUXILIARY FUEL TANKS.

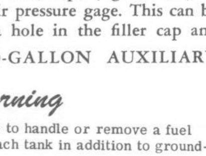
Warning

- Before any attempt is made to handle or remove a fuel tank, electrically ground each tank in addition to grounding the airplane.
- Make sure the ENGINE MASTER switch is in the "OFF" position and external power source is disconnected from airplane.
- Place the d-c power switch in the "OFF" position.
- Ensure that the EXTERNAL STORES EMERGENCY RELEASE circuit breaker is disengaged (left hand forward console) if the tanks are released manually by pulling JET EXT STORES handle. Stores installed on the other wing stations would be jettisoned electrically if the circuit breaker is engaged, since the power for this circuit is derived from the battery bus (Refer to figure 7-22).

1 Drain the tanks. (Refer to paragraph 1-35.)

2 Disconnect sway brace at wing fitting attachments.



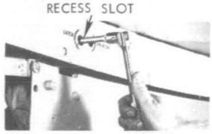


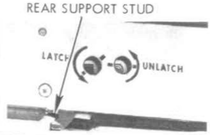
3 Position suitable padded cradle or padded stand under tank.

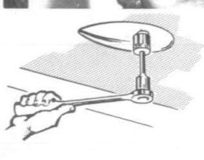
Caution Be sure the cradle is within 2 inches of tank.



4 Release tanks individually or simultaneously as desired. To release simultaneously, pull JET EXTL STORES handle on left forward vertical console. (Refer to paragraph 7-1420.) To release tanks individually, use a 3/8-inch drive wrench and position wrench in recess slot on inboard side of wing adapter beam, turning wrench to the left.







5 After tanks are removed, install cover plugs in wings or adapter beams and over air pressure and fuel feed line connections on tanks. Then, remove sway brace fittings from wings.

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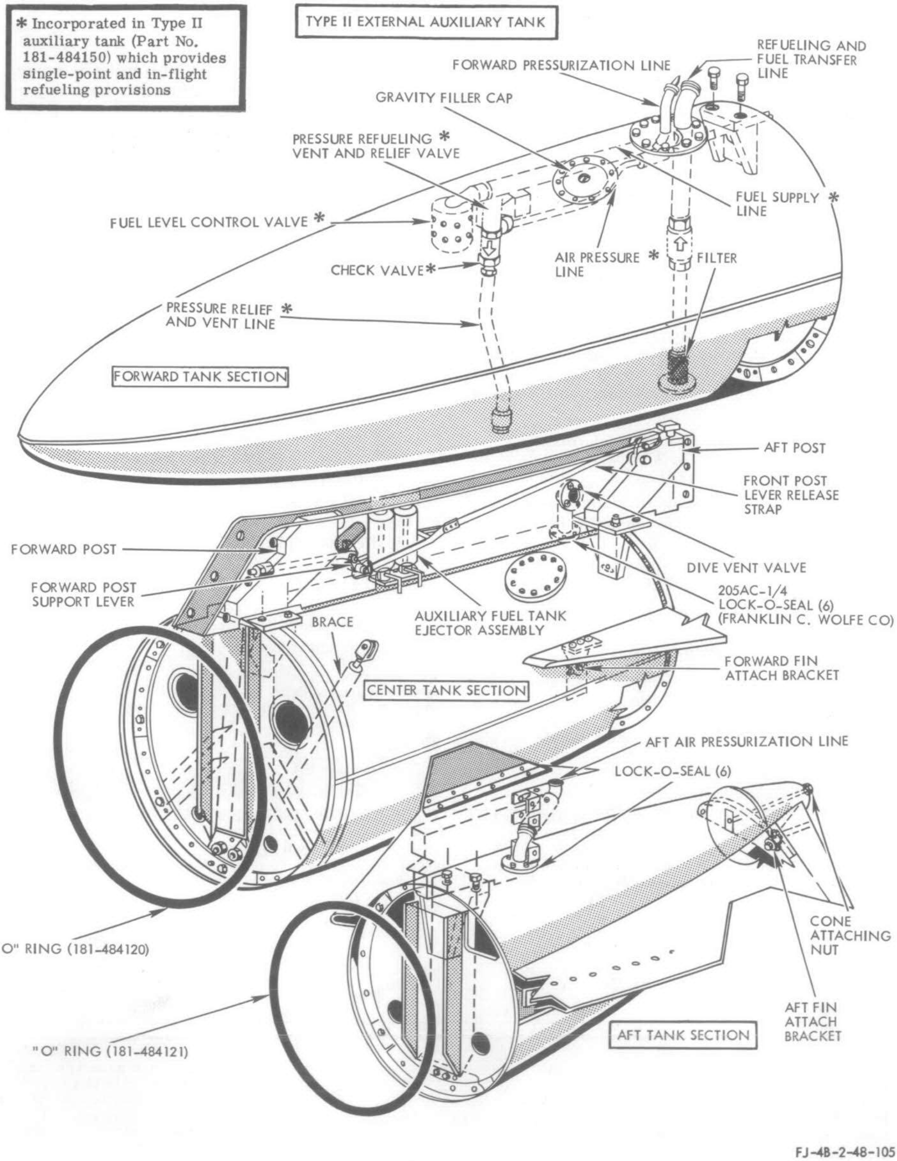
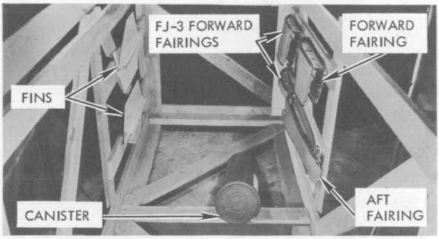


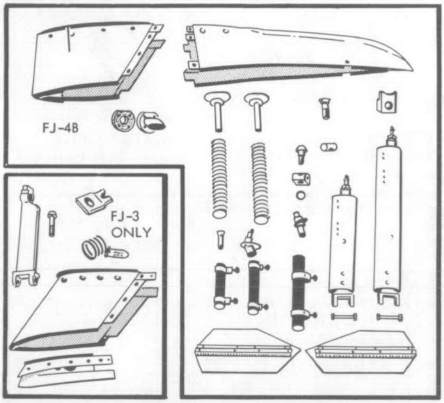
Figure No. 4-75. 200-Gallon Auxiliary Fuel Tank Maintenance

4-267. BUILD-UP OF 200-GALLON AUXILIARY FUEL TANKS.

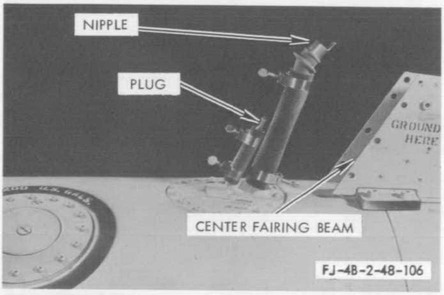
1 The Type II auxiliary fuel tank is shipped with provisions for the FJ-3 and FJ-4B type aircraft.



2 The following parts to build up the drop tank for installation are included in the canister and mounted to the shipping crate.



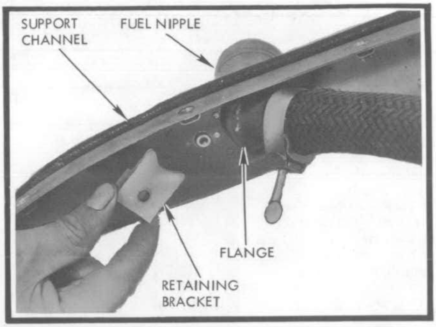
3 Install plug and hose at forward air line fitting and install nipple and hose at forward fuel line fitting.



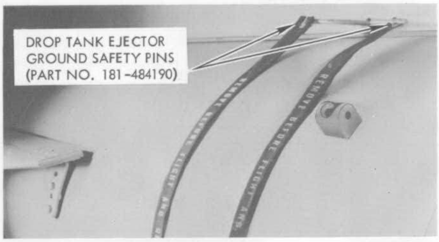
FJ-4B-2-48-106

4 Install forward fairing support channel to center fairing beam. Position fuel nipple through frame.

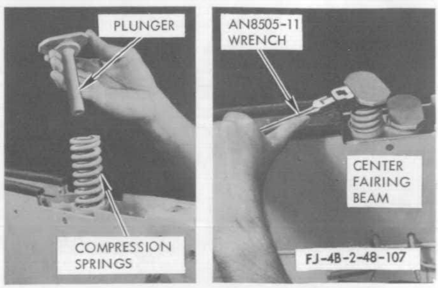
5 Install nipple retaining bracket over nipple flange.



Warning Be sure drop tank ejector ground safety pins (Part No. 181-484190) are installed securely in ejector shafts and identified with a red warning streamer before installing compression springs. When the compression springs are loaded, as in the following procedure, the tension on each spring is 474 pounds.

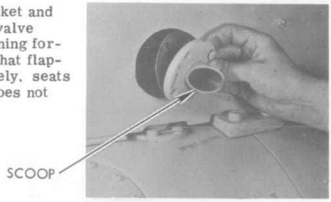


6 Insert compression springs in the ejector housing over ejector shafts and screw ejector plungers on shafts (compressing springs) until flush with top of center fairing beam. (Use AN8505-11 wrench to accomplish this.)

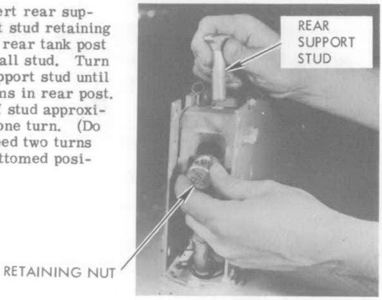


FJ-4B-2-48-107

7 Install gasket and dive vent valve with scoop opening forward. Check that flapper swings freely, seats squarely and does not stick open.

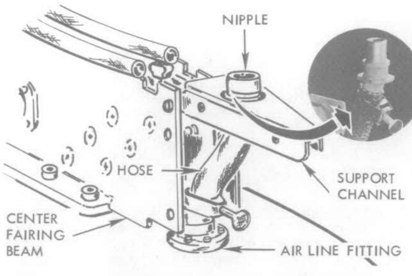


8 Insert rear support stud retaining nut into rear tank post and install stud. Turn rear support stud until it bottoms in rear post. Back off stud approximately one turn. (Do not exceed two turns from bottomed position.)

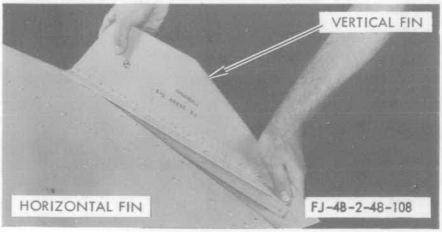


9 Install nipple and hose at aft air line fitting.

10 Install aft fairing support channel to center fairing beam.

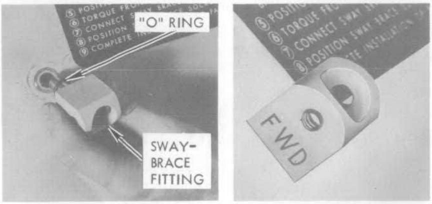


11 Install vertical fins to horizontal fins with tapered end positioned aft.

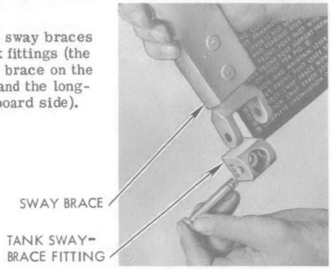


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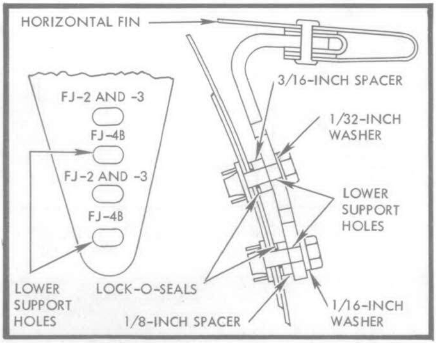
12 Install sway-brace fitting to tank with "O" ring between fitting and tank. "FWD" must face forward.

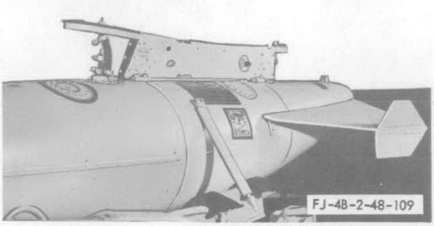


13 Install sway braces to tank fittings (the shorter sway brace on the inboard side and the longer on the outboard side).



14 Check tank fin position. Be sure fin is installed using the lower support holes and that spacers and washers are installed correctly.





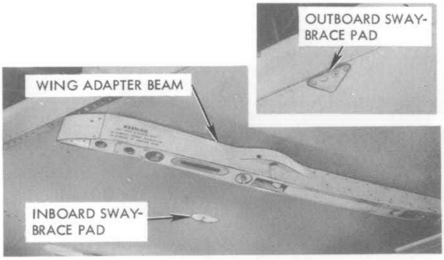
FJ-4B-2-48-109

4-268. INSTALLING 200-GALLON AUXILIARY FUEL TANKS.

1 Remove fuel and air pull-away fitting plugs from fittings on bottom of wing adapter beam.



2 If not installed, install wing adapter beam at buttock plane 105. (Refer to paragraph 7-150.)



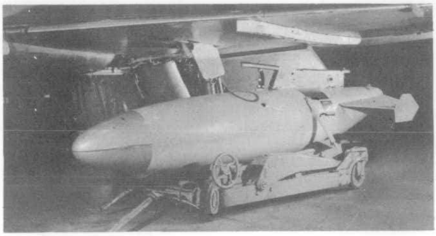
Warning Electrically ground each tank in addition to grounding the airplane, before installing fuel tanks that have contained fuel (if the tanks have not been purged).

3 Install sway brace wing pads on underside of wing.

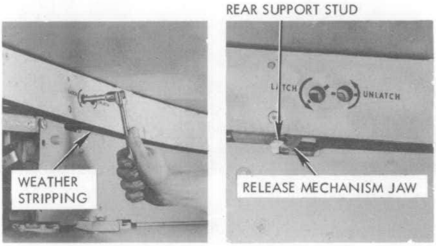
4 With tank on adjustable dolly, position under wing and raise tank into place.

Note If auxiliary fuel tanks being installed have Service Change number 511 complied with, check the adapter beam to ensure that Part I of the Service Change has been complied with on the front post support of the beam.

FJ-4B-2-48-110B

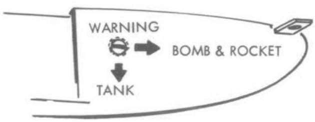


5 Engage rear support stud in wing adapter beam release mechanism jaw and secure by locking stud in inboard aft side of adapter beam.



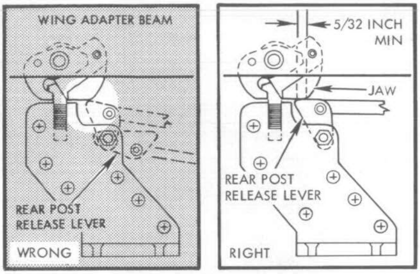
6 Be sure the microswitch control is in the "TANK" position.



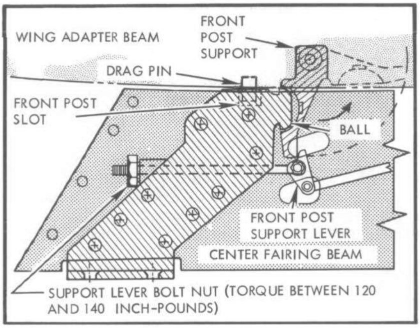


Caution Nose of tank must be supported to prevent bending of rear stud. Check to make sure that weather stripping is properly seated against wing adapter beam.

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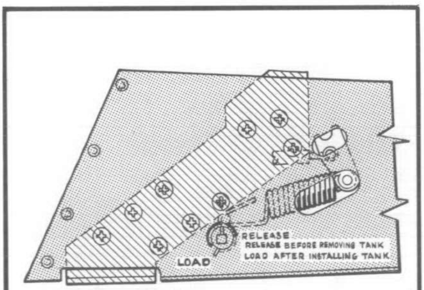


AFT (RIGHT-HAND SIDE)



FUEL TANKS NOT HAVING SERVICE CHANGE
NUMBER 511 COMPLIED WITH

FORWARD (LEFT-HAND SIDE)

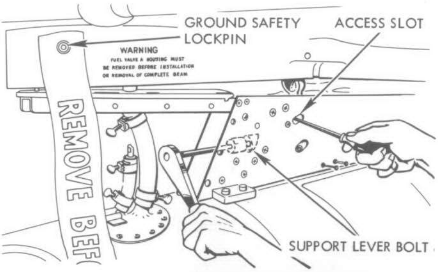


FUEL TANKS HAVING SERVICE CHANGE
NUMBER 511 COMPLIED WITH

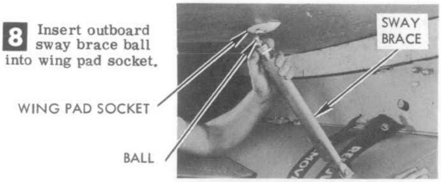
FJ-4B -2-48-207

7 Engage front post slot of center fairing beam with wing adapter beam drag pin. By working through access slot in side of center fairing beam, extend front post support of wing adapter beam and engage socket with ball on front post of center fairing beam. Position and maintain front post support lever behind front post support of wing adapter beam and torque nut on front post support lever bolt between 120 and 140 inch-pounds. Safety-wire nut to the two existing holes in adjacent beam fairing using AN995F47 lockwire.

Caution Install ground safety lockpin in forward end of adapter beam. Use Part No. E-3764



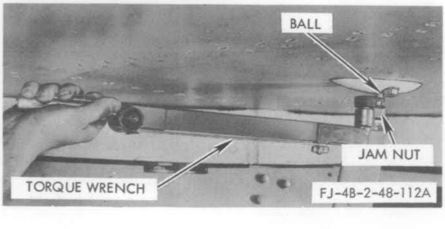
8 Insert outboard sway brace ball into wing pad socket.



9 Turn ball on inboard sway brace (shorter brace) so that sway brace is shortest possible length. Compress spring in outboard sway brace by forcing tank outboard. Snap inboard sway brace ball into wing pad socket.

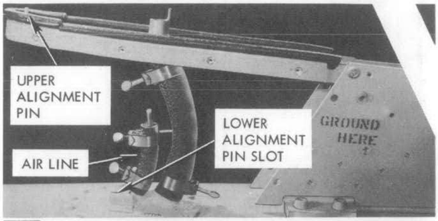
10 Preload sway braces by torquing ball counterclockwise on inboard sway brace from 125 to 150 inch-pounds. (This applies preload to sway braces of approximately 200 pounds.) It is acceptable if torque drops to approximately 100 inch-pounds after filling drop tank with fuel.

11 Torque jam nut from 100 to 120 inch-pounds (turn clockwise) while holding the ball on inboard sway brace.

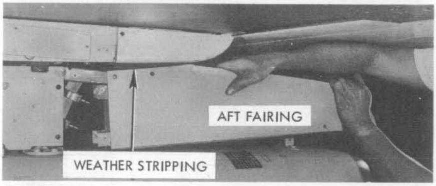


FJ-4B-2-48-112A

12 Install forward fairing. Be sure upper fairing alignment pin engages fully with adapter beam hole and that lower fairing alignment pin engages securely with slot just forward of plugged air line outlet. Weather stripping should seat against wing adapter beam.

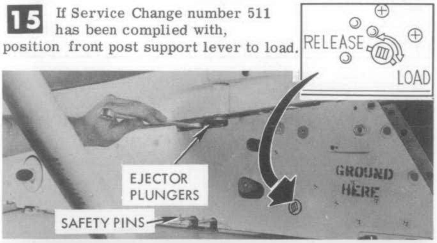


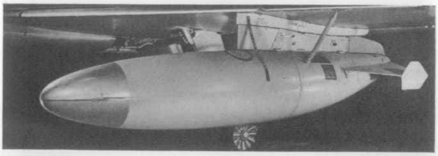
13 Install aft fairing. Be sure weather stripping seats against wing adapter beam.



14 Adjust ejector plungers snug against wing adapter beam. (This will permit easy removal of safety pins prior to flight and easy installation after flight.)

15 If Service Change number 511 has been complied with, position front post support lever to load.







FJ-4B-2-48-113A

150-GALLON AUXILIARY FUEL TANKS

4-269. 150-GALLON AUXILIARY FUEL TANKS.

4-270. The 150-gallon auxiliary fuel tanks consist of a Douglas Aircraft Company Aero 1A, 150-gallon tank (Part No. 5548328), supported by an Aero 7A force ejection rack mounted in a North American Aviation, Inc. furnished pylon. The tanks will provide maximum fuel capacity at wing buttock plane 153, external store station. This tank consists of the following internally mounted equipment (figure 4-76): a float switch, a vent and relief valve, a supply line connected to the lowest portion of the tank and incorporating a drain valve and strainer assembly, a refueling and transfer line and an air supply line. A gravity filler cap is provided for individually servicing the tank and an outside drain valve is accessible from the bottom side of the tank for periodic draining of condensation. The wing pylon equipment consists of a solenoid-operated shutoff valve, a fuel level control valve, numerous lines and fittings and an Aero 7A force ejection rack.

4-271. PRESSURE CHECKING 150-GALLON AUXILIARY FUEL TANKS TRANSFER SYSTEM.

4-272. The 150-gallon auxiliary fuel tanks transfer system may be pressure checked, with the engine operating, as follows:

a. Fabricate two gravity filler caps (figure 4-74) to incorporate a 0 to 25 psi air pressure gage.

b. Fill 150-gallon auxiliary fuel tank by use of the gravity filler. Be sure main fuel system is at least 200 gallons below capacity.

c. Install special gravity filler cap, which incorporates a 0 to 25 psi pressure gage, on each tank in place of regular gravity filler cap.

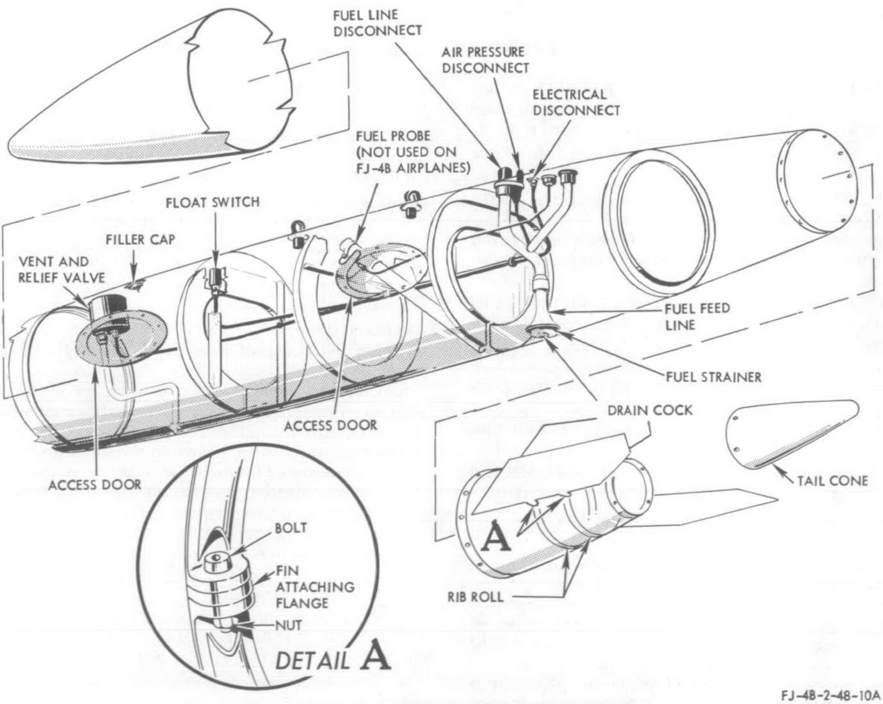


Figure No. 4-76. 150-Gallon Auxiliary Fuel Tank

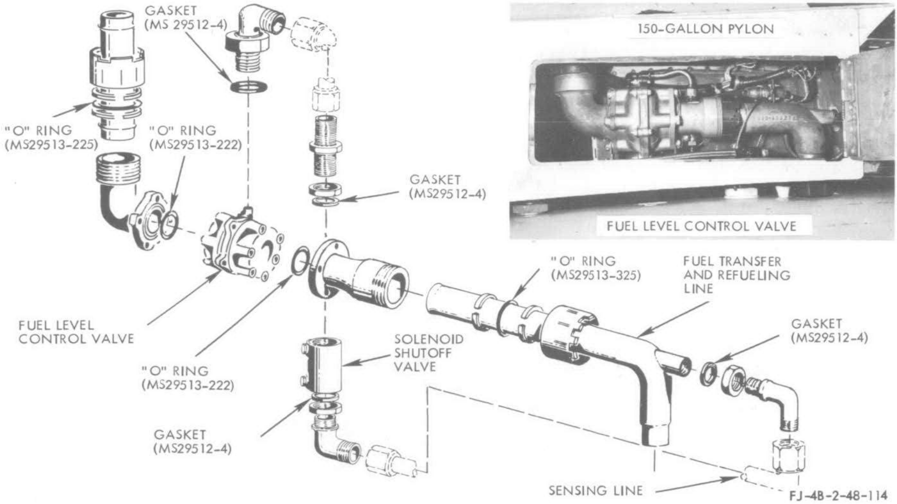


Figure No. 4-77. 150-Gallon Auxiliary Fuel Tank Pylon—Fuel System

d. Disengage both AFT FUEL TRANSFER PUMP and WING FUEL TRANSFER PUMP circuit breakers located on the left-hand rear console circuit-breaker panel.

e. Start and operate engine at 85 to 90% rpm. (Refer to paragraph 1-9.)

f. Place DROP TANK FUEL TRANSFER switch in the "OUTBD" position.

g. Pressure gage on each tank filler cap should read 7 to 9 psi (allow at least ½ minute for air pressure stabilization).

h. After 1½ minutes of operation with DROP TANK FUEL TRANSFER switch in "OUTBD" position, place switch "OFF" and shut down engine.

i. Fill auxiliary tanks with fuel. Each 150-gallon drop tank should take at least 15 U. S. gallons of fuel to fill the tank.

j. Replace regular gravity filler caps on each 150-gallon tank.

k. Engage AFT FUEL TRANSFER PUMP and WING FUEL TRANSFER PUMP circuit breakers.

4-273. 150-GALLON AUXILIARY FUEL TANK PYLON FUEL SYSTEM.

4-274. The fuel system of the 150-gallon auxiliary fuel tank pylon consists of a solenoid shutoff valve, a fuel level control valve and numerous lines and fittings (figure 4-77). The solenoid shutoff valve is used to shut off the sensing line to the level control valve to prevent the overboarding of fuel in the event the outboard drop tanks are jettisoned. The fuel level control valve controls the fuel level in the 150-gallon tank during single-point or in-flight refueling. The valve closes when the tank is full due to the action of the fuel sensing line.

4-275. REMOVING AND INSTALLING 150-GALLON AUXILIARY FUEL TANK PYLON.

Refer to paragraph 7-154.

4-276. CHECKING 150-GALLON AUXILIARY FUEL TANK PYLON FUEL SYSTEM.

4-277. To functionally check the fuel level control shutoff valve and the solenoid shutoff valve in the 150-gallon fuel tank pylon, proceed as follows:

a. Apply 10 psi air or nitrogen pressure to the main fuel line at the topside of the pylon. No airflow from the main fuel line at the bottom side of the pylon should be present.

b. Connect a 28-volt d-c power source to the airplane's external power receptacle. This will open the air solenoid shutoff valve. (On airplanes 141467j and subsequent, the OUTBD DROP TKS. switch, located in the single-point refueling receptacle well, must be positioned to "REFUEL.") A free flow of air from the main fuel line at the bottom of the pylon should be noted.

c. Disconnect the power supply and apply 10 psi air pressure to the main fuel line at the bottom of the pylon. There should be a free flow of air from the main fuel line at the top of the pylon.

d. Connect 28 volts dc to open the air solenoid shutoff valve (step b). Free flow of air from the main fuel line at the top of the pylon should be present.

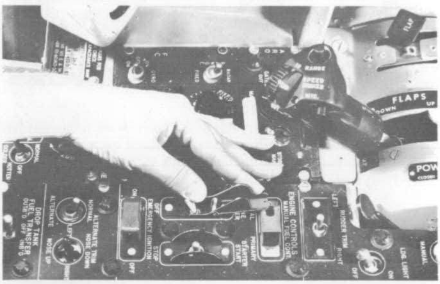
e. Remove the test equipment and connect the main fuel line.

4-278. REMOVING AND INSTALLING 150-GALLON AUXILIARY FUEL TANKS.



Warning

- Before any attempt is made to remove or handle a fuel tank, electrically ground each tank in addition to grounding the airplane.
- Make sure the ENGINE MASTER switch is in the "OFF" position and external power source is disconnected from airplane.



REMOVING

1 Drain the tanks. (Refer to paragraph 1-35.)

2 Position suitable padded cradle, stand or dolly under tank.

3 Open access doors on left- and right-hand sides of pylon.

4 Release tank by rotating the manual release knob counterclockwise.

5 After tanks are removed, install cover plugs in wings or pylons and over air pressure and fuel feed line connections on tanks.

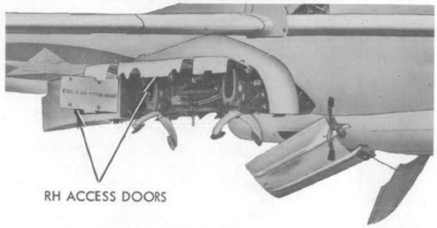
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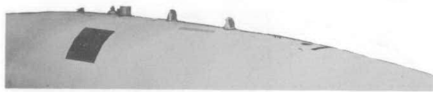
INSTALLING

1 Install 150-gallon auxiliary fuel tank pylon. (Refer to paragraph 7-154.)

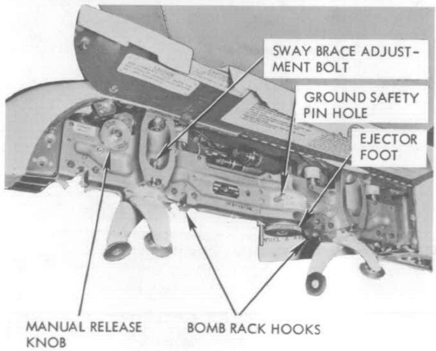
2 Open access doors on left- and right-hand sides of pylon.

150-GALLON TANK PYLON-RH WING





3 Open bomb rack hooks by rotating manual release knob counterclockwise. (Use socket wrench.)



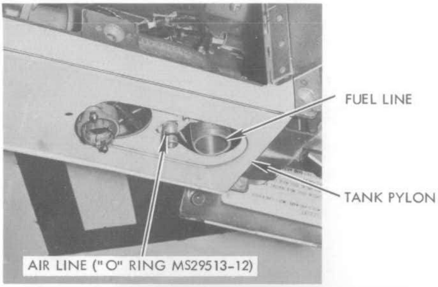
4 Screw ejector foot up into bomb rack sufficiently to clear the tank during tank installation. Raise sway brace adjustment bolts to provide tank clearance.

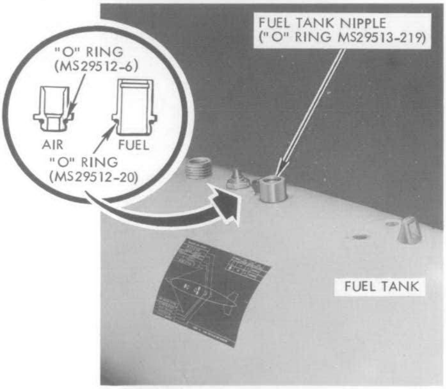
5 Position tank under wing on suitable pads or on an adjustable dolly and align with bomb rack.

Warning Connect a ground wire from the metallic structure of the tank to the metallic structure of the airplane. Ground the airplane with a separate ground wire from airplane to ground.

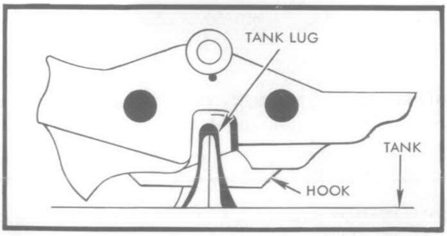
FJ-4B-2-48-116

6 Lubricate "O" rings with petrolatum (item 100, materials list) and install "O" ring (MS29513-12) in groove on outside of pylon air line fitting. Install "O" ring (MS29513-219) in groove inside of tank fuel nipple.





7 Raise tank (using dolly or E6085 fuel tank hoist strap with bomb hoist) until tank lugs enter bomb rack and hook recesses sufficiently to close rack hooks.



8 Install ground safety pin (E6042) in bomb rack.

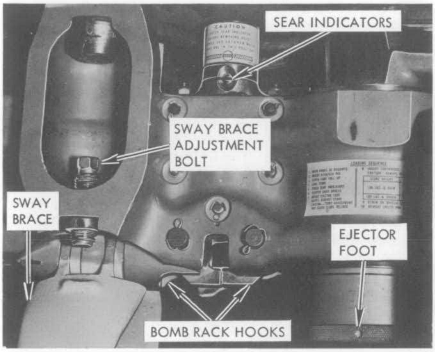
FJ-4B-2-48-117

9 Visually check sear indicators to ensure that bomb rack hooks are properly latched.

10 Screw ejector foot down until light contact is made with tank.

Warning Tight adjustment may cause tank release.

11 Adjust sway brace adjustment bolts (two bolts on each side of rack) to seat sway braces lightly against tank. Torque all sway brace adjustment bolts one-fourth turn; then tighten all adjustment bolts an additional one-fourth turn for a total of one-half turn.

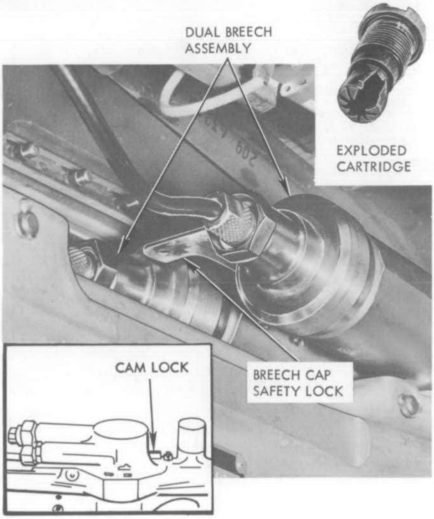


12 To install new cartridges, depress breech cap safety lock and remove breech caps. Turn breech cam lock (rear of breech) and pivot breech assembly outward. Remove old cartridges and install new Mark 25 primer cartridges in the adapters inside the dual breech.



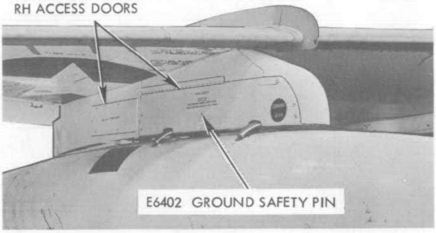
FJ-4B-2-48-118

Caution If cartridges have exploded as shown, remove the adapters from the breeches and clean fragments from both the breeches and the adapters before loading new cartridges.



13 Align dual breech with bomb rack until cam lock engages. Install breech caps and make certain breech cap safety lock fits behind back of caps.

Caution Do not fire rack without a cartridge in each breech chamber. Do not fire rack without a store or tank latched in place.



14 Connect electrical plug to drop tank electrical connection.

15 Close access doors on left- and right-hand sides of pylon. Be sure to reinstall ground safety pin after closing doors. Remove grounding wires.

FJ-4B-2-48-119

IN-FLIGHT REFUELING SYSTEM

4-279. IN-FLIGHT REFUELING SYSTEM.

4-280. The in-flight refueling system consists of a probe assembly mounted under the left wing at buttock plane 81 and extended approximately 72 inches forward of the wing leading edge. The system also contains numerous fittings, lines and fairings. The in-flight refueling system utilizes the auxiliary fuel tank transfer and feed lines to the fuel level control valve and the normal refueling system (figures 4-36 and 4-37). The in-flight refueling system refuels the entire fuel system: forward fuselage cell, aft fuselage cell, left and right wing tanks, 150-gallon auxiliary fuel tanks and the 200-gallon auxiliary fuel tanks (or buddy tanks).

4-281. FUNCTION OF IN-FLIGHT REFUELING SYSTEM.

4-282. When contact is made with the drogue of the tanker airplane and the probe nozzle is forced into the drogue, the spring-loaded sleeve is pushed aft (away from the fixed nose) to create an opening. At the same time, the fixed nose of the probe has opened the drogue. Fuel from the drogue (tanker airplane) enters the opening in the nozzle of the probe and flows through the mast into the drop tank transfer and refueling line. This line, in turn, joins the single-point refueling system at the dual level control valve and also routes fuel to both drop tanks. The dual level control valve, the two-way check valves, the flow limiter valve, the refueling lines and the vent lines also serve the in-flight refueling system.

4-283. TROUBLE SHOOTING IN-FLIGHT REFUELING SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
RESTRICTED FUEL FLOW.		
Check valve sticking.	Perform pressure check.	Clean or replace valve.
FUEL LEAKING FROM PROBE NOZZLE.		
Faulty check valve.	Perform pressure check.	Clean or replace valve.
FUEL LEAKING AROUND WING INTERCONNECTOR TUBE.		
Interconnector tube retaining nut loose.	Visually check for fuel leakage.	Tighten interconnector tube retaining nut; if leak persists, replace "O" ring. (See figure 4-78.)
Faulty or worn "O" ring.	Visually check for fuel leakage.	Replace "O" ring. (See figure 4-78.)
FUEL LEAKING AT PROBE MAST TO SUPPORT ASSEMBLY MOUNTING.		
Mast to support assembly locknut and jam nut not torqued properly.	Visually check for fuel leakage.	Torque jam nut and locknut (figure 4-78).
Faulty or worn "O" ring.	Visually check for fuel leakage.	Replace "O" ring (figure 4-78).
FUEL LEAKING AT NOZZLE ADAPTER.		
Faulty or worn nozzle adapter to mast "O" ring.	Visually check for fuel leakage.	Replace "O" ring (figure 4-78).

4-284. OBSTRUCTION AND PRESSURE CHECK OF IN-FLIGHT REFUELING SYSTEM.

4-285. To perform an obstruction and pressure check of the in-flight refueling system, proceed as follows:

a. Fabricate a test adapter (figure 4-79) and connect a coupling and drogue assembly to the outlet side; connect a single-point refueling receptacle to the inlet side.

Note

Step a. is not necessary if the proper ground fuel check adapter assembly is available. For Type A-1 nozzle, use SK-905 (208100), Flight Refueling, Inc. assembly (figure 4-79); for Type MA-2 nozzle, use 208000 (Flight Refueling, Inc.) assembly. (Refer to paragraph 4-289.)

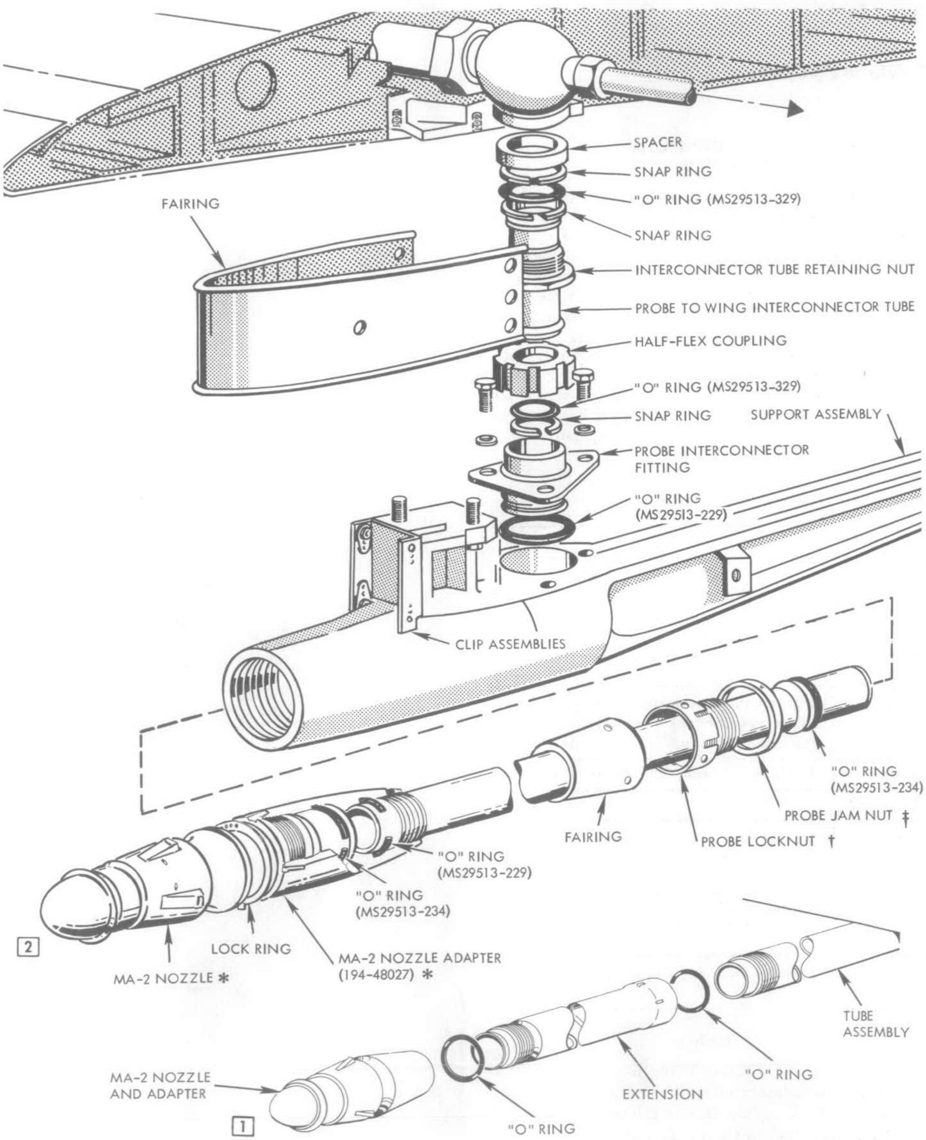
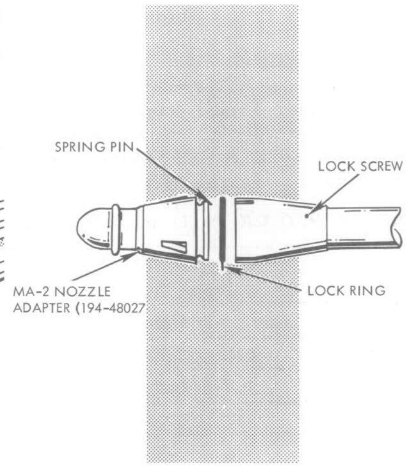


Figure No. 4-78. In-flight Refueling Probe

Note

The in-flight refueling probe should be checked daily for corrosion. If corrosion exists, it should be removed by polishing with No. 1 fine steel wool and then applying SAE-10 or lighter oil.



* Install MA-2 nozzle and MA-2 nozzle adapter in accordance with Navy Technical Order No. 29-55

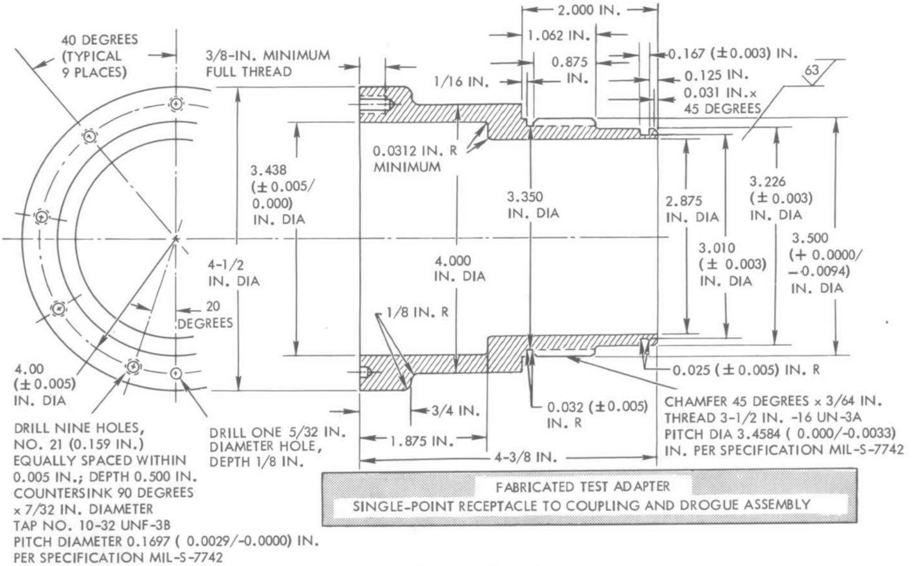
† Torque from 250 inch-pounds minimum to 300 inch-pounds maximum

‡ Torque from 800 inch-pounds minimum to 500 inch-pounds maximum

[1] Airplanes 139531i and subsequent having Service Change Number 513 complied with

[2] Airplanes 139531i and subsequent not having Service Change 513 complied with

1. Finish 181-0024, 4130 steel bar (4-1/2 in. diameter by 4-3/8 in.) per Specification MIL-S-6758 Cond (D) (1).
2. Machine per Specification FA6-125.
3. Magnetic inspection per Specification MIL-I-6868 (PR3-1).
4. 125 ✓ All machined surfaces except as noted.
5. Heat-treat - normalize 125,000-140,000 psi per Specification MIL-H-6875 (PR5-1).



Note If available, use ground fuel check adapter (208100 or SK-905) (Flight Refueling Inc.) in place of fabricating this test adapter for Type A-1 nozzle.

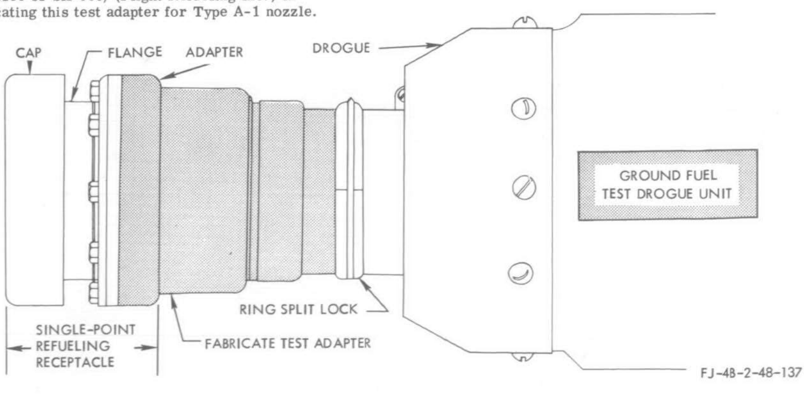


Figure No. 4-79. Ground Fuel Check Adapter Assembly—Type A-1 Nozzle

b. Connect ground fuel check adapter (paragraph 4-289) to the single-point refueling receptacle.

c. Position ground fuel check adapter assembly over end of probe nozzle and connect a nitrogen pressure test line as outlined in steps a., c. and e. of paragraph 4-159.

d. Install E2083-11 plug in main vent bayonet opening and E2595 plug in main vent drain line opening; install plug in pressure relief and vent line opening at bottom of each auxiliary tank; cap or seal all other openings in the fuel system.

e. Provide nitrogen pressure (paragraph 4-159) at $3\frac{1}{2}$ psi to the single-point refueling receptacle on the ground fuel check adapter assembly.

f. Remove plug in pressure relief and vent line opening on left-hand auxiliary tank and note substantial nitrogen flow. Replace plug.

g. If auxiliary tanks are not installed, remove plug from the left-hand auxiliary fuel tank transfer line outlet (underside of wing) and note substantial nitrogen flow or install pressure gage and note approximately $3\frac{1}{2}$ psi pressure indication. Replace plug. If auxiliary tank is installed, replace the filler cap with test gage filler cap (figure 4-74) and note approximately $3\frac{1}{2}$ psi pressure. (Allow substantial time for nitrogen pressure to build up and equalize.)

h. With $3\frac{1}{2}$ psi nitrogen pressure applied to probe, close nitrogen supply shutoff valve after pressure stabilizes. The fuel system and probe assembly must maintain approximately $3\frac{1}{2}$ psi pressure without leakage for a period of 15 minutes. This pressure can be determined by reading the test gage filler cap on the left-hand auxiliary tank or by installing a test gage at the auxiliary fuel transfer line outlet underneath the left-hand wing.

i. Remove nitrogen supply, refueling adapter and drogue test unit. Replace test gage filler cap with regular filler cap and/or remove the test gage and replace the plugs at the auxiliary fuel transfer line outlet. Remove plugs from main fuel system vent bayonet and main vent drain line. If system does not check out satisfactorily, refer to trouble shooting charts in paragraphs 4-155, 4-245 and 4-283.

4-286. TESTING IN-FLIGHT REFUELING SYSTEM.

4-287. To test the in-flight refueling system, provide a ground fuel check adapter assembly (step a., paragraph 4-285). Use ground fuel check adapter assembly in step a. of paragraph 4-285 for the A-1 nozzle, or GA-2 ground fuel check adapter for the MA-2 nozzle (paragraph 4-289), and proceed as follows:

a. Install ground fuel check adapter over probe nozzle.

b. Connect single-point refueling nozzle from fuel truck to single-point refueling receptacle on ground fuel check adapter.

Note

If airplane's fuel system is completely filled, it will be necessary to partially defuel the airplane (paragraph 1-35).

c. Completely service the airplane through the in-flight refueling probe until the dual level control valve shuts off the fuel supply.

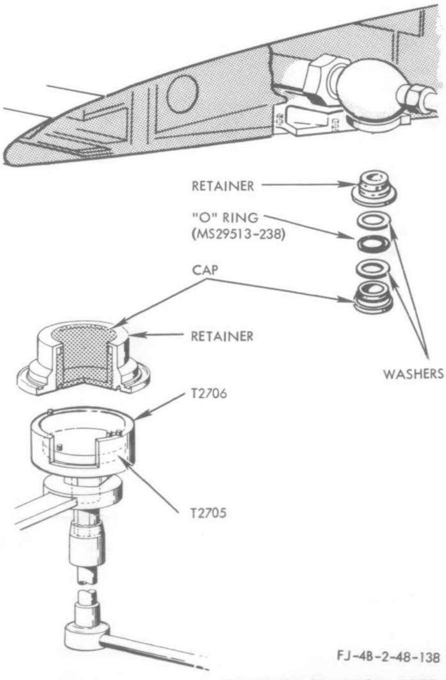
d. Check for fuel leakage at probe to wing connector, connector tube to support assembly and probe mast to support assembly. Also, check the fuel quantity indicator and note if all fuel tanks are full. Check the auxiliary fuel tanks for full capacity by removing filler caps. If system is not completely full, refer to trouble shooting charts in paragraphs 4-155, 4-245 and 4-283.

e. Remove single-point refueling nozzle and ground test unit from probe assembly.

4-288. REMOVING AND INSTALLING IN-FLIGHT REFUELING PROBE CAP.

To ensure proper installation of the retainer and cap on airplanes with in-flight refueling provisions, two special wrenches are provided.

By using the two wrenches as shown, the retainer can be held stationary while the cap is removed or installed. If the retainer should be loosened during removal of the cap, leakage may result unless the retainer is retorqued to 60 foot-pounds by using the T2706 retainer wrench. Also, if the probe assembly is removed, an MS29513-238 "O" ring must be installed and the cap torqued to 40 foot-pounds as shown.



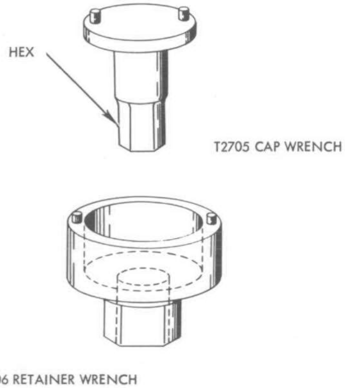
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1 Place the T2705 cap wrench inside the T2706 retainer wrench. Position wrenches flush against the retainer and the cap in the wing, making sure that the pins on the wrenches are in the holes in the cap and retainer.

2 With a 1-5/16-inch open end wrench, hold the T2706 wrench stationary and with a 3/4-inch socket and ratchet, rotate the T2705 wrench to remove the cap.

3 After the cap has been removed, use the T2706 retainer wrench to retighten the retainer to make sure that it is torqued within 60 foot-pounds.

Note When installing the cap in retainer, use same method. Make sure retainer is torqued to 60 foot-pounds. Install MS29513-238 "O" ring and install cap. Torque cap to 40 foot-pounds.



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4-289. INSTALLING AND REMOVING IN-FLIGHT REFUELING PROBE GROUND FUEL CHECK ADAPTER — TYPE MA-2 NOZZLE.

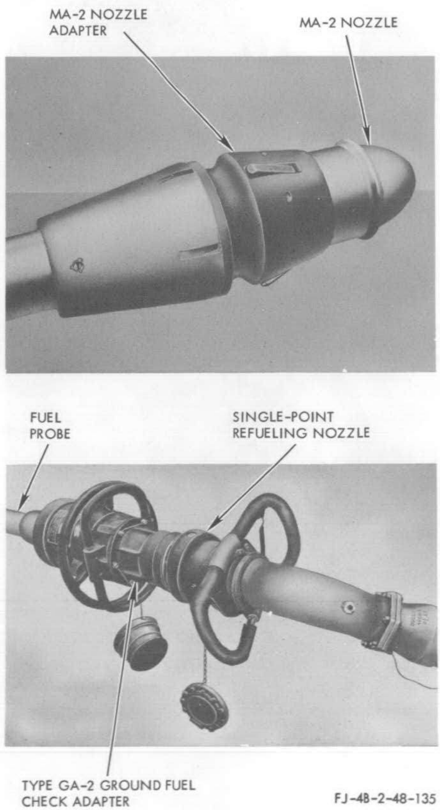
INSTALLING

1 Remove cap and plug from ground fuel check adapter (Part No. 208000, Flight Refueling, Inc).

2 Position ground fuel check adapter over nozzle. (Squeeze release handles together if necessary.)

3 Connect single-point refueling nozzle to ground fuel check adapter.

Note This ground fuel check adapter will fit the Type MA-2 nozzle only.



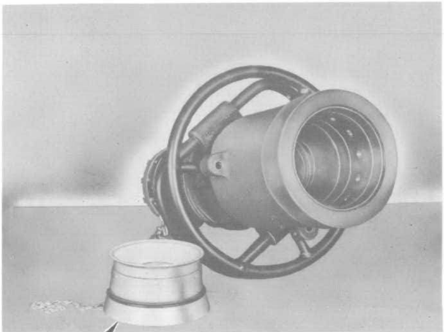
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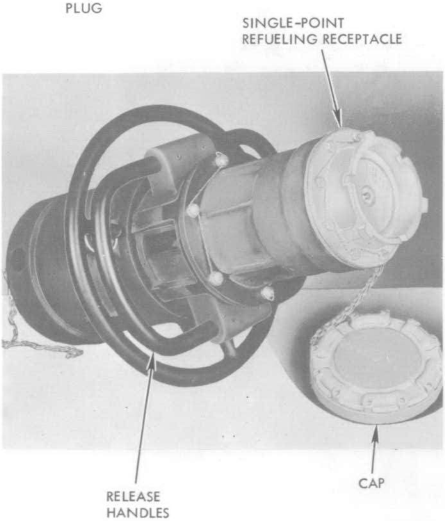
REMOVING

1 Remove single-point refueling nozzle.

2 Remove ground fuel check adapter by squeezing release handles together.

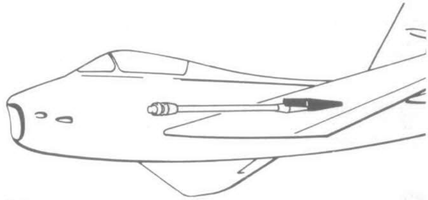
3 Install cap and plug in ends of ground fuel check adapter.





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4-290. REMOVING AND INSTALLING IN-FLIGHT REFUELING PROBE.



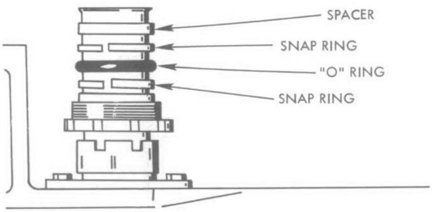
Note Removal procedure is the opposite of installing

1 Remove three flush head screws from lower side of wing.

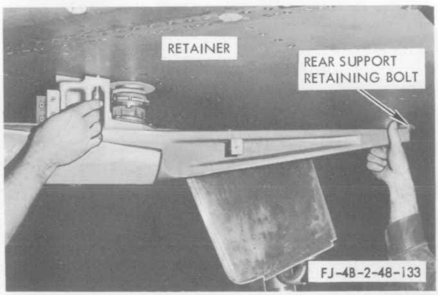
2 Remove cap from lower side of wing fuel tank with T2705 wrench. Be sure to torque retainer to 60 foot-pounds with T2706 wrench.

Note Retain the three screws and cap as they must be replaced when probe assembly is removed.

3 Slip snap ring, "O" ring, snap ring and spacer over interconnector tube. Install ground wire from probe to airplane and airplane to ground.



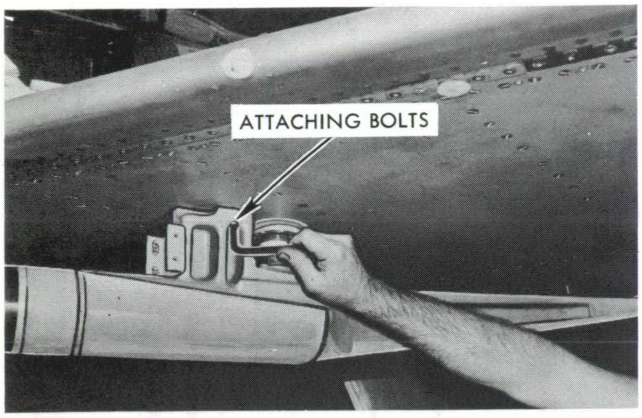
4 Attach probe assembly to underside of wing with three bolts. Be sure to install washer on each bolt and a washer and spacer on rear support assembly retaining bolt.

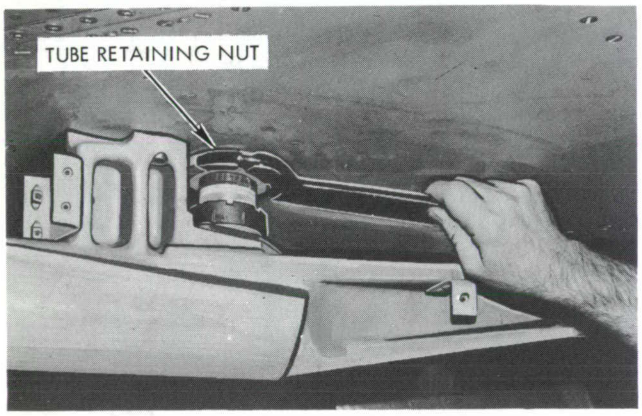


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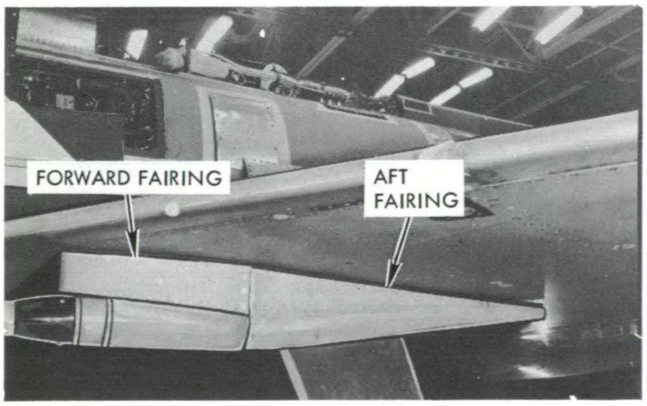
Note Tighten attaching bolts and interconnector tube retaining nut simultaneously. (Use standard torque values.)

5 Install lockwire (AN93541) from half-flex coupling to interconnector tube retaining nut.





6 Install fairing assemblies.



7 Perform an obstruction and pressure check. (Refer to paragraph 4-284.)

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4-290A. INSTALLING IN-FLIGHT REFUELING PROBE NOZZLE. To install the probe nozzle, see figure 4-78 and proceed as follows:

a. Screw the nozzle adapter on probe mast until bottomed. Torque to standard torque value.

Note

The Teflon inserts incorporated in the nozzle adapter will lock the adapter to the probe mast.

b. Install lock ring and nozzle to probe nozzle adapter. Torque to standard torque value.

c. Bend lock ring lobe into adapter groove to safety nozzle to adapter. If adapter groove fails to align, repeat installing of nozzle with lock ring positioned differently.

d. Perform an obstruction and pressure check (paragraph 4-284) or a flow test (paragraph 4-286).

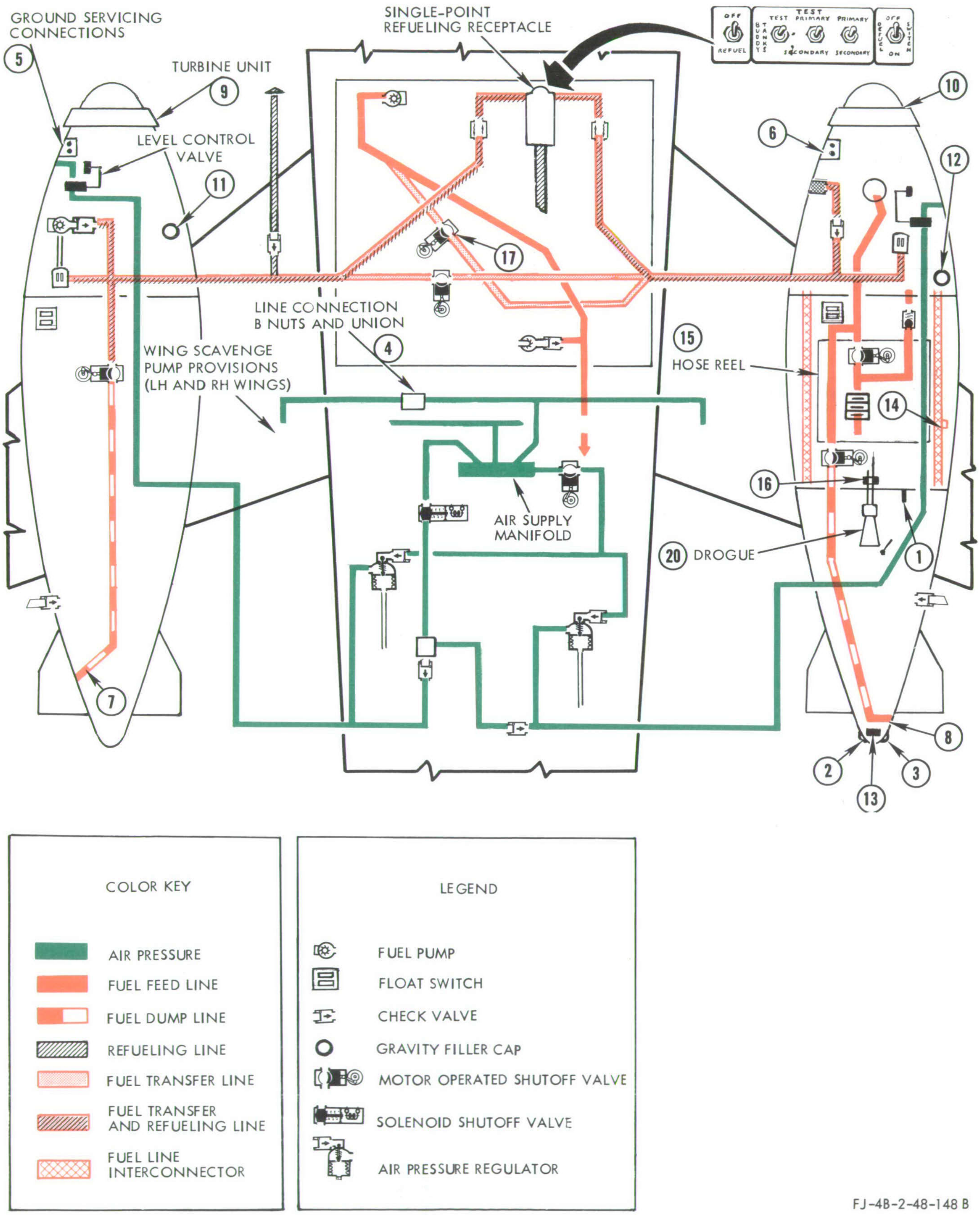


Figure No. 4-80. In-flight Refueling Tanker System—Schematic

IN-FLIGHT REFUELING TANKER SYSTEM

4-291. IN-FLIGHT REFUELING TANKER SYSTEM.

4-292. The in-flight refueling tanker system consists of two symmetrical underwing-mounted fuel tanks, one located under each wing at wing buttock plane 105.0. The left-hand tank (fuel tank, figure 4-82) contains 344 U.S. gallons of fuel and the right-hand tank (reel tank, figure 4-81) contains 224 U. S. gallons of fuel plus a 26-inch diameter collapsible drogue and hose reel unit. Fuel can be transferred from the airplane's internal tanks to the buddy tanker system or vice versa. The buddy tanker can be fueled through the airplane's single-point refueling system or in-flight refueling probe. This installation also provides for store jettisoning capabilities. The structure of both tanks is of aluminum alloy skin and frame construction and the supports are made of aluminum alloy die forging. Both tanks are supported by the Aero 7A bomb racks incorporated in the universal pylon (paragraph 7-137) which provides fuel and electrical pull-away fittings. The left-hand fuel tank contains the following equipment: a complete hydraulic system powered by a ram air-driven turbine, a hydraulically driven fuel pump, a pressure refueling system (consisting of a pressure relief and vent valve and a fuel level control valve) and a dump system (consisting of a motor-operated shutoff valve and an overboard dump tube). The right-hand reel tank contains two separate fuel cells, a 120-gallon fuel cell at the front and a 104-gallon fuel cell aft, with a dry area in the center section for the reel and related equipment. The reel tank contains the following equipment: a complete hydraulic system powered by a ram air-driven turbine, a hydraulically driven fuel pump, a pressure refueling system, a fuel dump system, a fuel flow transmitter, a refueling hose reel, a drogue and related equipment. A tanker control panel, located in the cockpit on the vertical console, contains the following: a TRAIL—REWIND switch, an INTERNAL FUEL TRANS switch, a DUMP switch, a GUILLOTINE switch and three indicator lights. In addition to the tanker control panel, a fuel quantity transfer meter is located on the instrument panel. The drop tank transfer switch is used for emergency transfer of buddy tank fuel, and the emergency drop tank release system (figure 4-72) is used for emergency jettisoning of the buddy tanks. For complete maintenance and overhaul instructions on the in-flight refueling tanker system (buddy tanker), refer to the Handbook of Overhaul Instructions (NAVAER 03-100-503).

4-293. FUNCTION OF IN-FLIGHT REFUELING TANKER SYSTEM.

4-294. With buddy tanks installed on the airplane, and using the buddy tanker control panel in the cockpit, the system will function as follows:

a. On buddy tanker control panel (figure 4-83), position the switches as follows: (1) The MANUAL REFUEL—DUMP switch to "OFF." (2) GUILLOTINE switch to "OFF." (3) INTERNAL FUEL TRANS switch to "OFF." (4) TRAIL—REWIND switch to "REWIND." (5) In ground handling, the guillotine ground safety switch in the tank should be actuated.

b. On the left-hand radio bay circuit-breaker panel, close the following circuit breakers: BUDDY TANK EMER POWER, BUDDY TANK POWER, BUDDY FUEL DUMP and FLOAT TEST & DROP TANK REFUEL.

c. The following circuits are energized: (1) Power is applied up to the guillotine switch through the rewind switch. (a) Power is applied to the coil of the dump relay but a ground must be provided by the fuel dump switch and rewind switch. (2) Emergency power is available at the guillotine switch via the rewind switch. (3) Fuel tank and reel tank dump valves are energized (closed). (4) The cross ship fuel transfer valve is energized (closed). (5) The fuel hose shutoff valve is energized (closed). (6) The reel tank fuel pump hydraulic control valve is energized (closed). (a) Power is applied to the thermal safety switches. These will actuate if the hydraulic system reaches 230°F, thereby completing a circuit to energize the reel tank fuel pump cutoff valve (closed). (7) The internal fuel transfer valve is energized (closed).

d. Place the TRAIL—REWIND switch to "TRAIL." (1) Power is removed from rewind circuits, guillotine switch and the dump relay coil. (2) Power is supplied to fuel transfer indicator circuit (ground is not complete to the indicator at this time). (3) Ground circuit is removed from fuel dump and made available for the manual refuel switch. (4) Trail relay is energized: (a) Cross ship fuel transfer valve opens. (b) Power is removed from the closed side of the fuel hose shutoff valve and is applied to the contacts of the full trail relay which controls the power to the six foot from full trail circuit. (c) A circuit is completed between the amber (ready) light and fuel hose shutoff valve. (d) The primary and secondary solenoids of the dual level float valves are energized. (e) The fuel tank and reel tank air turbines are unfeathered. (f) A potential is applied to the manual refuel relay and is removed from the dump relay. The ground circuit is not complete at this time. (g) Hose floodlight is turned on if EXTERIOR LIGHTS master switch of airplane is "ON." (h) Full trail relay is energized. Trail override solenoid is energized. Red in transit light is turned on. Holding circuit for full trail relay is completed. Power is removed from the fuel hose shutoff valve open winding. (i) Drogue release solenoid is actuated, causing the drogue to be ejected into the air stream. (j) Level control solenoid is energized in the fuel tank only. (5) Hose begins to trail. (a) The drogue-stowed switch deactuates at the time the drogue is released and completes a circuit for rewind power. (b) Drogue solenoid cutout switch deactuated, which breaks circuit to drogue release solenoid. Full trail relay control switch actuated, which breaks initial energizing circuit for full trail relay. Full trail relay remains energized through holding circuit. (c) Drogue slowdown

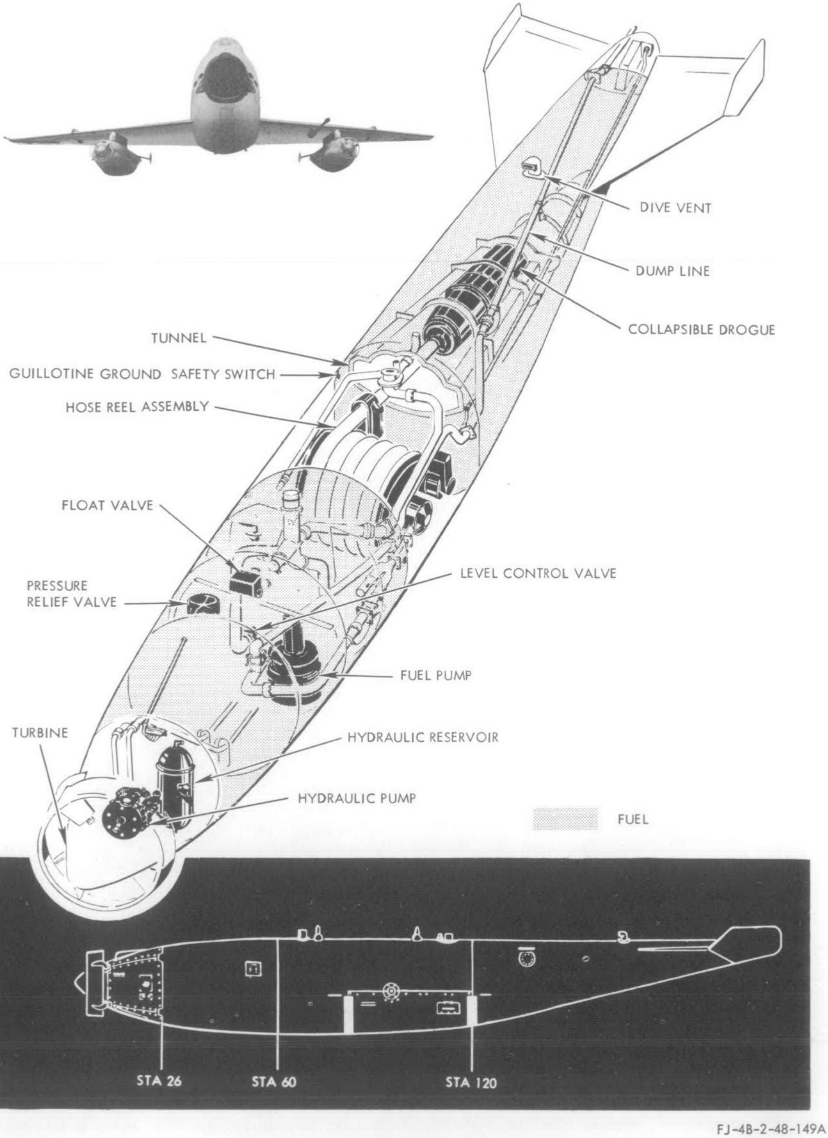


Figure No. 4-81. In-flight Refueling Reel Tank

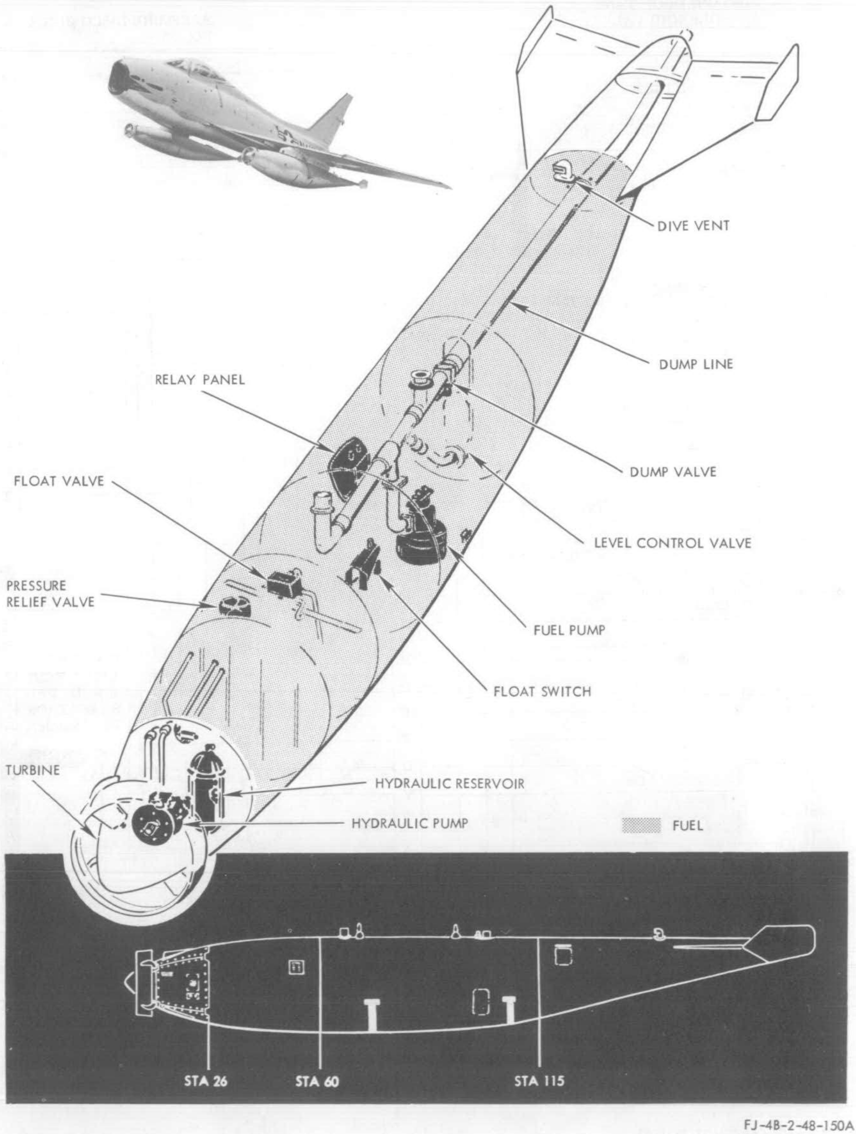


Figure No. 4-82. In-flight Refueling Fuel Tank

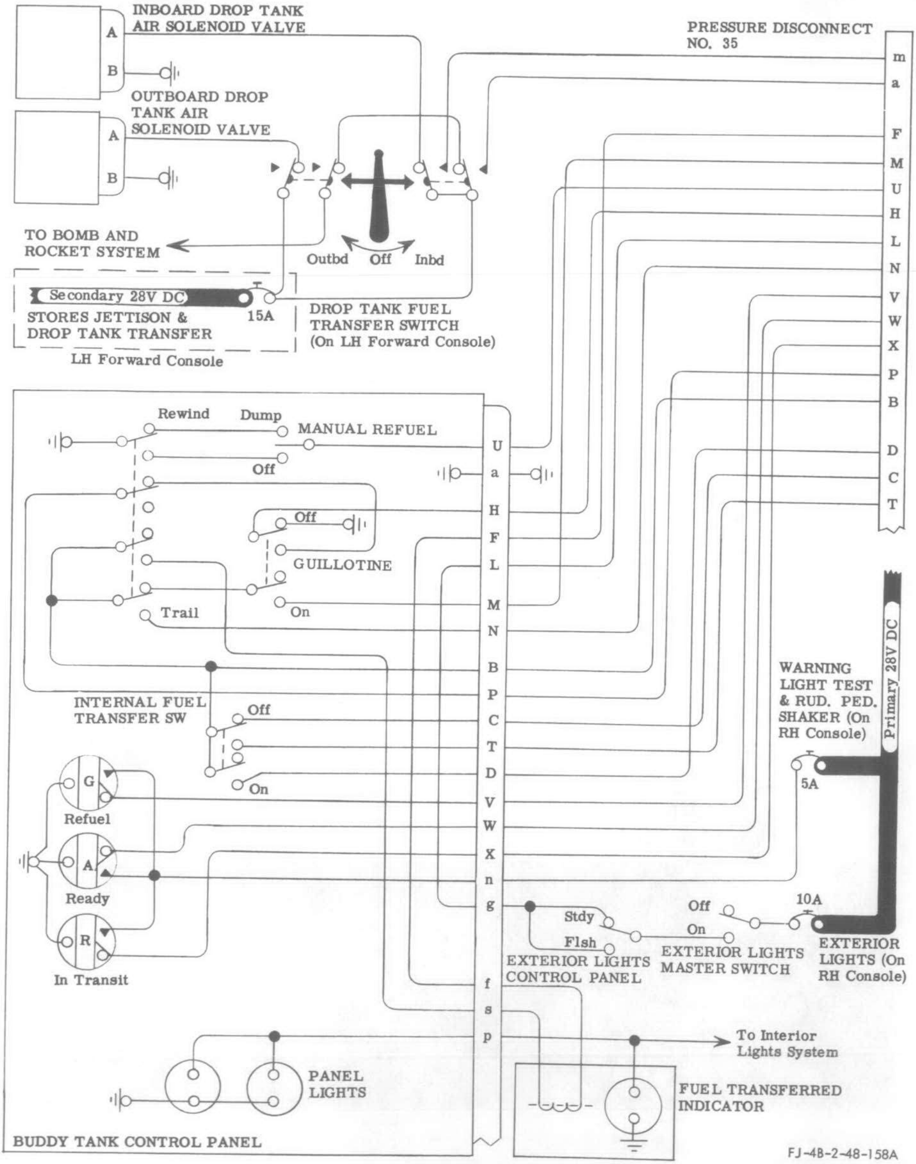


Figure No. 4-83. In-flight Refueling Tanker System—Electrical Schematic (Sheet 1)

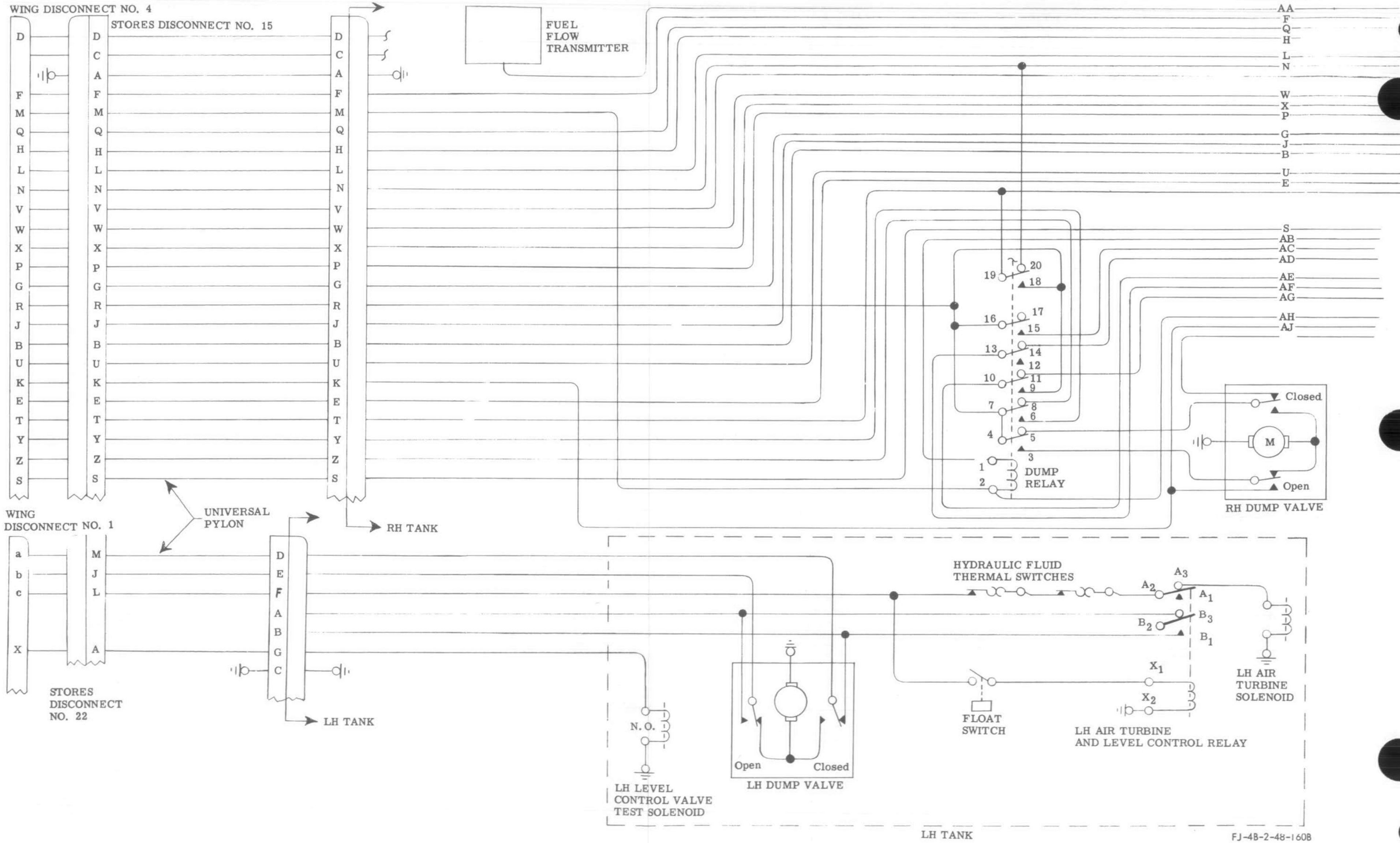
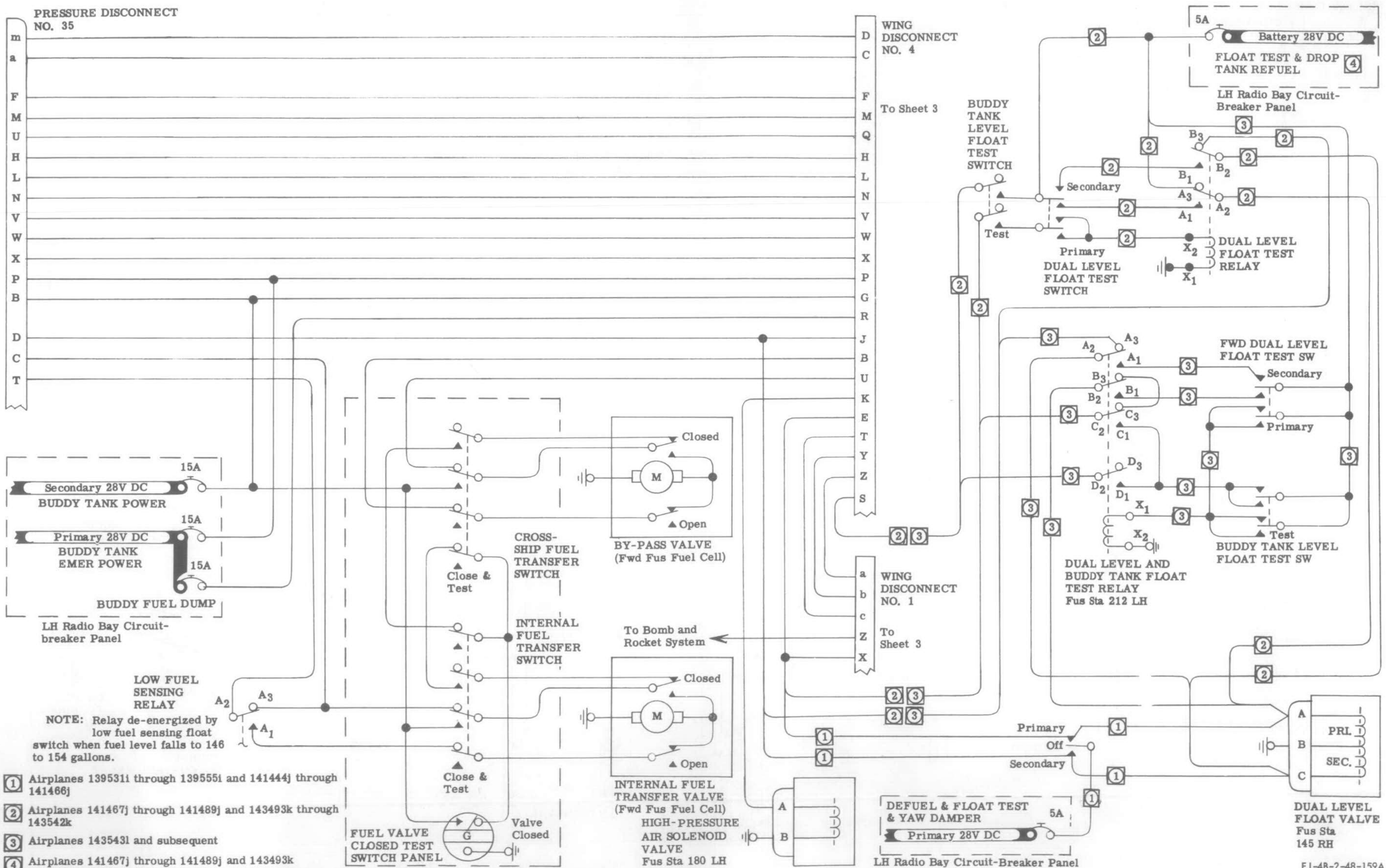


Figure No. 4-83. In-flight Refueling Tanker System—Electrical Schematic (Sheet 3)



NOTE: Relay de-energized by low fuel sensing float switch when fuel level falls to 146 to 154 gallons.

1. Airplanes 139531i through 139555i and 141444j through 141466j
2. Airplanes 141467j through 141489j and 143493k through 143542k
3. Airplanes 143543l and subsequent
4. Airplanes 141467j through 141489j and 143493k and subsequent

Figure No. 4-83. In-flight Refueling Tanker System—Electrical Schematic (Sheet 2)

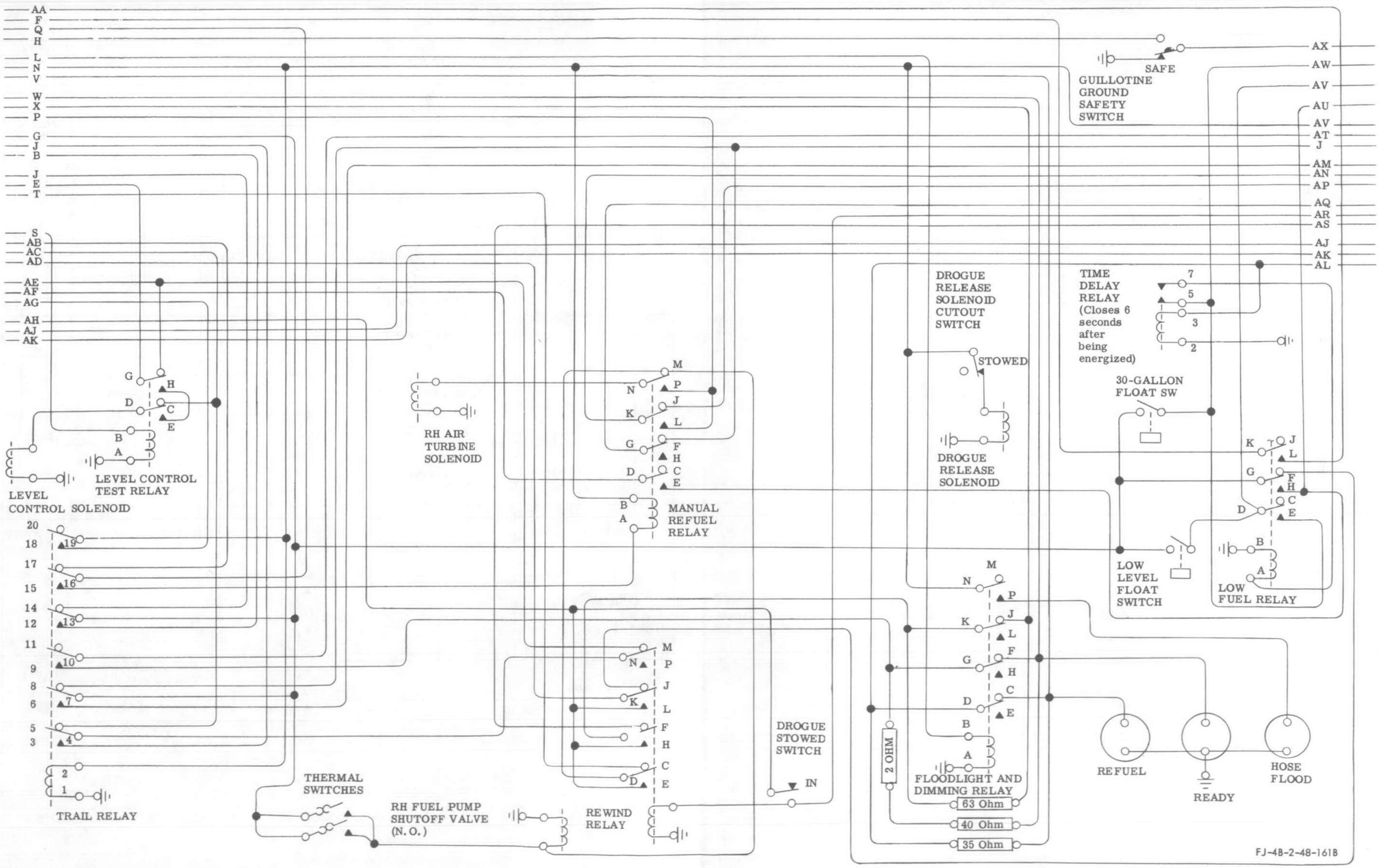


Figure No. 4-83. In-flight Refueling Tanker System—Electrical Schematic (Sheet 4)

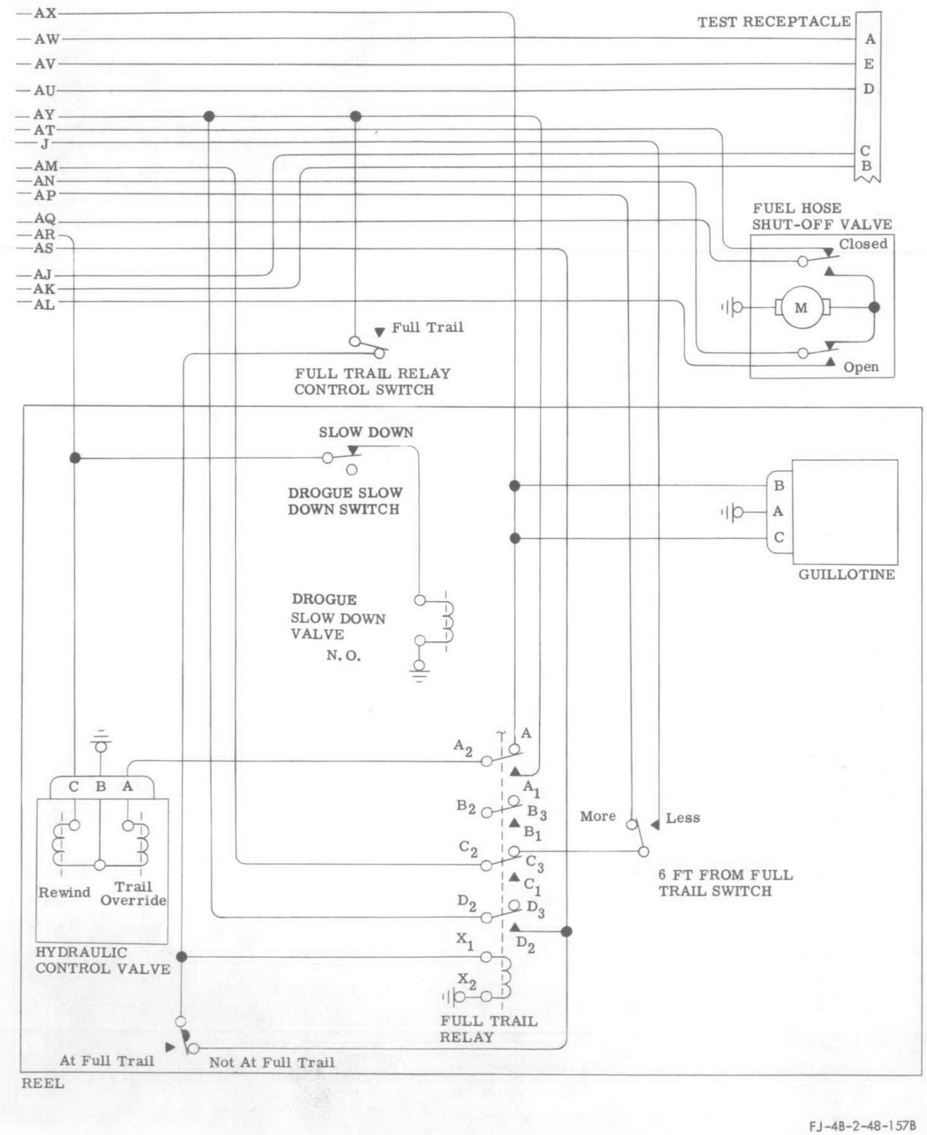
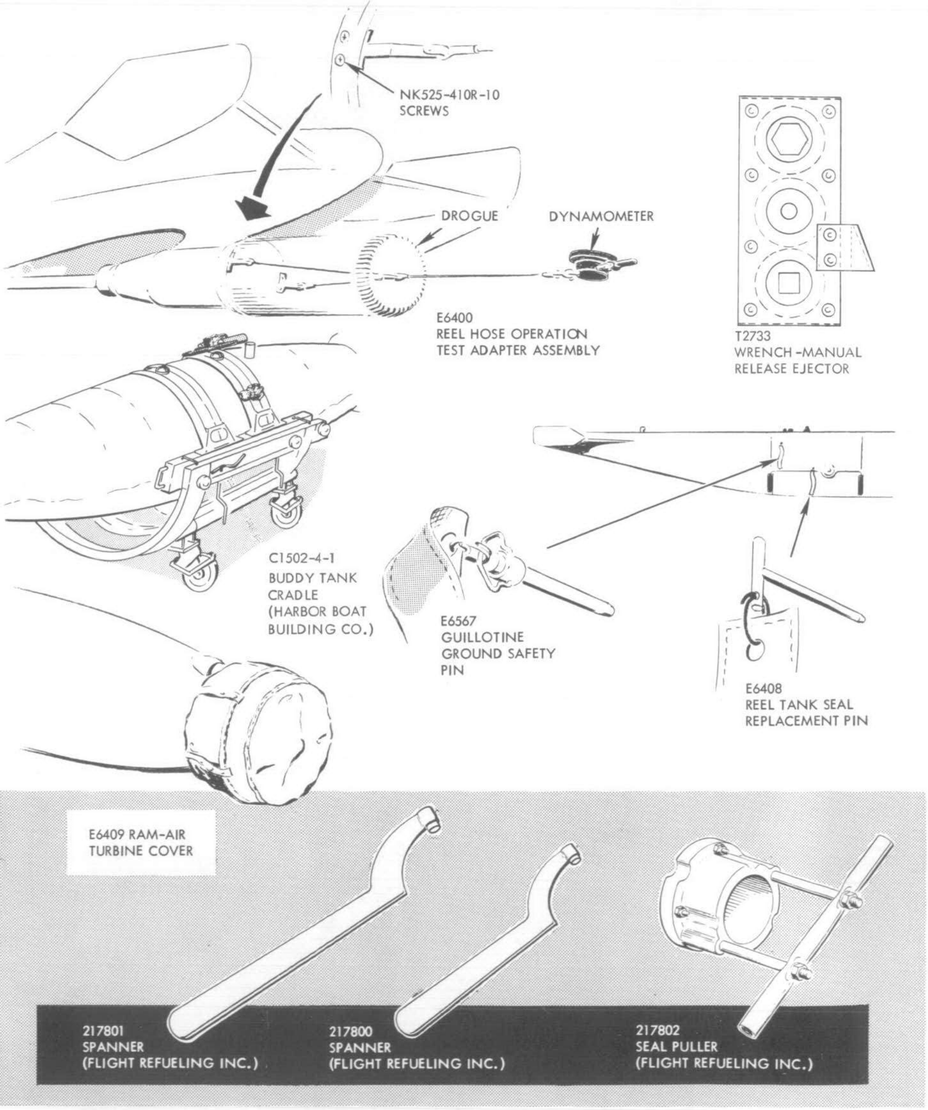
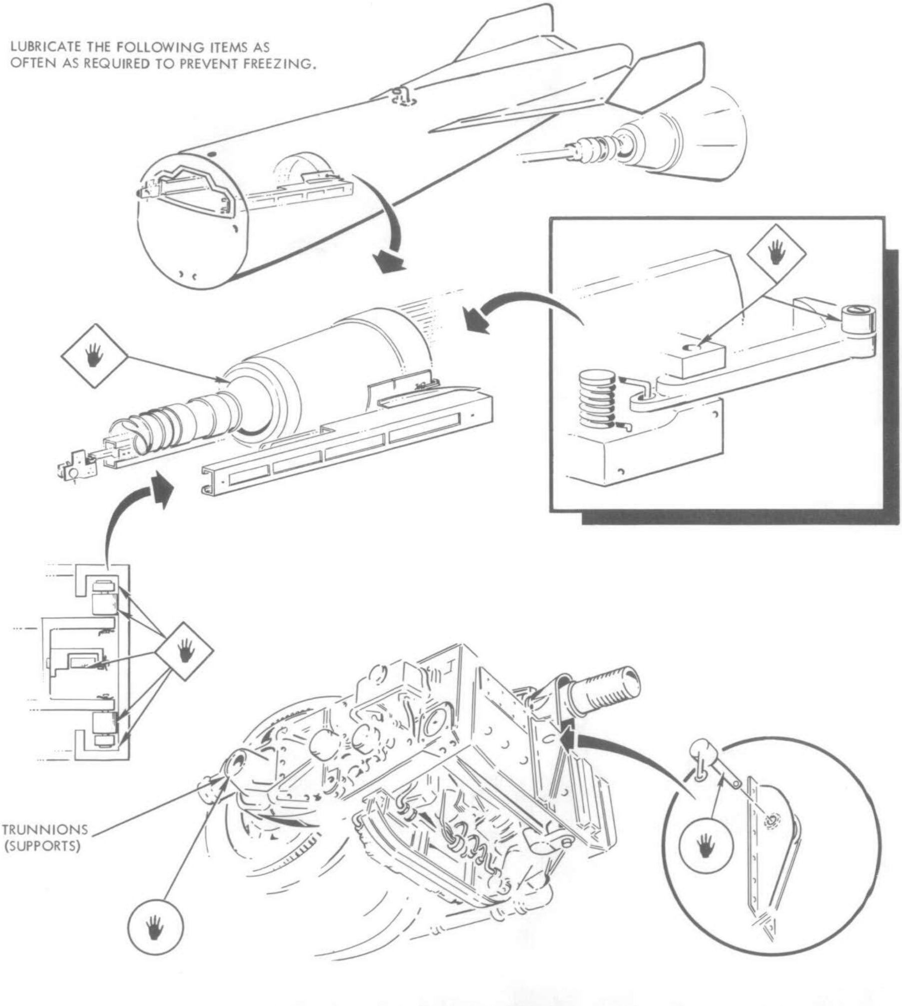


Figure No. 4-83. In-flight Refueling Tanker System—Electrical Schematic (Sheet 5)



FJ-4B-2-48-188B

Figure No. 4-84. Ground Handling Equipment



IDENTIFICATION	LUBRICANT	APPLICATION	FREQUENCY			
MIL-G-7421	SILICON ANTI-REFRIGERANT	HAND	○	INSTALLATION	◇	10 CYCLES OR AS REQUIRED

FJ-4B-2-48-186

Figure No. 4-85. Lubrication Requirements

switch actuates. (d) Six foot from full trail switch actuates to the "LESS" position. (6) When the hose reaches full trail, the full trail switch is actuated. (a) Full trail relay is de-energized. Trail override solenoid is de-energized. Red in transit light is out. Circuit is completed to fuel hose shutoff with the close winding energized. The amber (ready) light is on.

e. When receiver makes contact, the hose is rewound 6 feet or more. (1) Six foot from full trail switch deactuates. (a) Fuel hose shutoff valve opens. Amber (ready) lights go out and green refuel lights go on. (2) Time delay relay is actuated. (a) After a 6-second time delay, circuit is completed to the low fuel relay. (b) Low fuel relay actuated if right-hand tank contains 30 gallons or more of fuel. Power is removed from reel tank fuel pump shutoff valve, allowing valve to open and fuel to transfer. Ground circuit is completed to fuel transfer indicator. 28-volt d-c power is applied to pin "A" of test receptacle.

f. Receiver will be fueled except under the following conditions: (1) Hose is extended and actuates the six foot from full trail switch. This will be indicated by the green lights going out. The amber lights will be on. (2) The tanker pilot selects "REWIND" and a normal rewind sequence is in operation. (3) Thermal safety switches in reel tank are actuated, causing the fuel pump to shut off. Fuel transfer indicator will stop. (4) Fuel level in right-hand tank is low. (5) Sequence system or any of its components fail.

g. If refueling fails to occur due to sequence system failure, the "MANUAL REFUEL" position is selected. (1) Ground is completed to manual refuel relay and relay is actuated. (a) Power is removed from the fuel pump shutoff solenoid, allowing pump to operate. (b) Fuel hose shutoff valve is opened. The green light is on. (c) Reel tank turbine is unfeathered. (2) Pilot must place the MANUAL REFUEL—DUMP switch to "OFF" position or TRAIL—REWIND switch to "REWIND" to terminate the refueling operation. (3) The only type of sequence failure that will also prevent manual refueling is the failure of the fuel hose shutoff valve to open. This valve must be open to allow any fuel transfer to occur. Should the turbine or pump shutoff fail, gravity transfer will not be affected.

h. Receiver airplane is refueled and backs off, actuating the six foot from full trail switch. (1) The fuel hose shutoff valve closes. (a) Green lights are off. (b) Amber lights are on. (c) The time delay relay is de-energized. Contacts will open in 11 seconds to deactuate the low fuel relay. Reel tank fuel pump cutoff valve is energized closed. The fuel pump will stop. The fuel transfer indicator ground circuit is open and indication of fuel transfer stops. (2) Tanker is ready to service another receiver airplane.

i. TRAIL—REWIND switch on tanker control panel is moved to "REWIND." (1) A ground circuit is switched from the manual refuel relay to the dump relay. (2) Power is removed from the fuel transfer indicator system. (3) Power is made available for guillotine. (4) Trail relay is de-energized. (a) Cross ship fuel transfer valve will close. (b) Power is applied to the close side of fuel hose shutoff valve from the secondary bus. (c) Primary solenoid circuit of the dual level float valve is de-energized. (d) The amber light is off. (5) Fuel tank turbine is feathered. Trail power is removed from reel tank turbine but rewind power will keep turbine release solenoid energized until rewind cycle is complete. (6) Power is removed from the coil of the manual refuel relay. (7) Hose floodlight is off. (8) Fuel tank level control solenoid is de-energized. (9) When TRAIL—REWIND switch is in "REWIND," (a) rewind solenoid is energized (hose rewinds). (b) Rewind relay is energized. Reel tank turbine release solenoid is energized by rewind power continuing turbine operation. Red in transit light is on. Reel tank fuel shutoff valve is energized by circuit through rewind switch, stopping hydraulic power to fuel pump. (c) Power is available at the coil of the dump relay but a ground must be provided by the dump switch. (10) As the hose rewinds, (a) the full trail switch deactuates, (b) six foot from full trail switch deactuates, (c) hydraulic slowdown switch actuates 10 feet from stowed position, (d) hydraulic slowdown valve is energized and hose slows down, (e) the drogue enters tunnel and (f) full trail relay control switch is deactuated and the drogue-stowed and drogue release solenoid cutout switches are actuated. (11) Drogue-stowed switch is actuated. (a) The rewind solenoid is de-energized. (b) Rewind relay is de-energized after drogue-stowed switch is actuated. Red in transit light is out. The reel tank turbine release solenoid is de-energized and the turbine feathers.

j. "DUMP" is selected while the hose is rewinding (not stowed). (1) The dump relay is energized. (a) Reel tank and fuel tank, primary dual level float and aft dual level float solenoids are energized (airplanes 143543l and subsequent). (b) Fuel tank turbine unfeathers. (c) Reel tank and fuel tank dump valves open. (d) High-pressure air solenoid is energized. (e) Reel tank fuel pump shutoff solenoid is de-energized, allowing the pump to operate. (2) The hose continues to rewind at a slower than normal rate. (3) Fuel is dumped from both the fuel and reel tanks.

k. "DUMP" is selected after the drogue is stowed. (1) Dump relay is energized to cause the same operations as in step j. except: (a) reel tank turbine is energized by dump power in place of rewind power; (b) rewind sequencing is not occurring, permitting the fuel to dump at a faster rate.

l. INTERNAL FUEL TRANS switch is placed to "TRANSFER." (1) Secondary solenoid of dual level float is energized. (2) Internal fuel transfer valve opens. (3) Internal fuel transfer valve will remain open, except when the fuel reaches a low level in the forward fuselage cell (950 pounds total internal) as follows: (a) low level float switch actuates, de-energizing the low level sensing relay; (b) internal fuel transfer valve closes.

m. Guillotine "ON" position is selected if hose fails to rewind (TRAIL—REWIND switch must be in "REWIND").

(1) Rewind power is removed from the rewind circuits. (a) Rewind solenoid cannot be energized. (b) When the rewind relay cannot be energized, the red in transit light goes out, the reel tank turbine is feathered and the reel tank fuel pump shutoff valve is energized by secondary power instead of rewind power. (c) Power is removed from the dump relay. (2) Trail override solenoid is energized. (3) Guillotine charge is fired and the hose and drogue drop away.

4-294A. FUNCTION OF IN-FLIGHT REFUELING TANKER SYSTEM RELAYS.

a. LOW FUEL SENSING RELAY — Remains energized until fuel in tanker aircraft drops to 950 pounds. De-energizing of the relay routes power to the closed circuit of the internal fuel transfer valve, preventing further transfer of fuel from the internal cells to the buddy tanks.

b. DUAL LEVEL FLOAT TEST RELAY — Energized by actuating the dual level float test switch to "PRIMARY" or "SECONDARY." This connects the battery bus to the primary or secondary solenoid of the dual level float valve.

c. TANK FULL RELAY (fuel tank)—De-energized until the fuel in the fuel tank is depleted. With an empty tank, the relay is energized and removes power from the left-hand air turbine solenoid causing the fuel tank turbine to feather.

d. LEVEL CONTROL TEST RELAY—Energized by actuating the buddy tank level float test switch. This switches the level control valve (reel tank) from the dump circuit to the buddy tank level float test circuit.

e. TRAIL RELAY—Energized by placing the TRAIL—REWIND switch to "TRAIL." It will remain energized until the TRAIL—REWIND switch is repositioned to "REWIND."

f. REWIND RELAY — Cannot be energized until the TRAIL—REWIND switch is placed to "REWIND," the GUILLOTINE switch is "OFF," and the drogue-stowed switch is deactuated (drogue not stowed).

g. DUMP RELAY—Is energized when the following conditions are met: TRAIL—REWIND switch to "REWIND," GUILLOTINE switch to "OFF" and the MANUAL REFUEL—DUMP switch in the "DUMP" position.

h. TIME DELAY RELAY (6 seconds closing)—The coil will be energized when the fuel hose shutoff valve is positioned to full open. Six seconds later, the contacts close.

i. FLOODLIGHT AND DIMMING RELAY—Energized by turning on the exterior lights.

j. LOW FUEL RELAY—Energized by closing the contacts of the 6-second time delay relay, provided there is *more* than 30 gallons of fuel in the reel tank. As fuel drops below 30 gallons, the 30-gallon float switch opens. Nothing happens at this time as a holding circuit is set up through the low level float switch. When fuel drops to a low level, the low level float switch opens. This will de-energize the low level relay.

k. MANUAL REFUEL RELAY—To energize this relay, the TRAIL—REWIND switch must be in the "TRAIL" position, the trail relay energized and the MANUAL REFUEL—DUMP switch in the "MANUAL REFUEL" position.

l. FULL TRAIL RELAY—Energized when the TRAIL—REWIND switch is placed to "TRAIL" and the full trail relay control switch is de-energized. A holding circuit through the full trail switch keeps the relay energized until the hose gets to the full trail position. At full trail, the relay de-energizes and remains that way through the rest of the refueling and rewinding cycles. The energizing circuit is broken by actuation of the full trail control switch when the drogue is ejected.

4-294B. FUNCTION OF IN-FLIGHT REFUELING TANKER SYSTEM ELECTRICAL SOLENOIDS.

a. TRAIL OVERRIDE SOLENOID—Energized when the TRAIL—REWIND switch is positioned to "TRAIL." It will remain energized until the full trail relay de-energizes when the hose reaches the full trail position. The trail override solenoid will also be energized when the guillotine circuit is energized.

b. REWIND SOLENOID—Energized by positioning the TRAIL—REWIND switch to the "REWIND" position, provided the GUILLOTINE switch is "OFF" and the drogue slowdown switch is deactuated (drogue extended).

c. REEL TANK AIR TURBINE SOLENOID—Energizing this solenoid allows the blades of the turbine to unfeather. The solenoid can be energized in four normal ways: (1) through deactuated contacts of the manual refuel and rewind relays with the TRAIL—REWIND switch in "TRAIL"; (2) actuating the TRAIL—REWIND switch to the "REWIND" position through actuated contacts of the rewind relay and deactuated contacts of the manual refuel relay; (3) directly from the BUDDY TANK EMER POWER circuit breaker through actuated contacts of the manual refuel relay (MANUAL REFUEL—DUMP switch to "MANUAL REFUEL"); (4) when in "DUMP" and "REWIND" simultaneously. The solenoid will de-energize when the TRAIL—REWIND switch is in the "REWIND" position and the rewind relay is de-energized (drogue-stowed switch actuated).

d. REEL TANK FUEL PUMP SHUTOFF VALVE—The purpose of this valve is to stop the flow of hydraulic fluid between the turbine (source) and the right-hand fuel pump. The valve is normally open to permit the passage of fluid. It must be energized electrically to close the valve and turn off the fuel pump. This valve will be energized by electrical power in the following situations: (1) during "REWIND" through the rewind relay and dump relay; (2) directly from the secondary bus when the hydraulic fluid overheats; (3) through the low fuel relay when the fuel reaches a low level in the reel tank during "TRAIL" operation. The valve is de-energized during the following situations: (1) dump, (2) manual refuel and (3) when the right-hand tank contains more than 30 gallons with the TRAIL—REWIND switch in the "TRAIL" position.

e. FUEL TANK AIR TURBINE SOLENOID—During "TRAIL" or "DUMP" the solenoid is energized, allowing the turbine to unfeather. The solenoid will de-energize when fuel in the left tank is exhausted, the TRAIL—REWIND switch is in the "REWIND" position or the hydraulic fluid overheats.

f. LEVEL CONTROL VALVE TEST SOLENOID (left-hand)—This valve is energized during the following operations: (1) actuating the buddy tank level float test switch; (2) whenever the TRAIL—REWIND switch is in "TRAIL"; (3) when "DUMP" position is selected.

g. LEVEL CONTROL VALVE (reel tank) — This valve is energized during the following operations: (1) actuating the buddy tank level float test switch; (2) when "DUMP" position is selected.

h. DROGUE RELEASE SOLENOID—This solenoid is energized when the hose is stowed and the TRAIL—REWIND switch is positioned to "TRAIL." As soon as the drogue is released, the solenoid is de-energized through the deactuation of the drogue release solenoid cutout switch.

i. DUAL LEVEL FLOAT VALVE. (1) Primary Solenoid—Energized by actuating the dual level float test switch or during the "TRAIL" or "DUMP" operation. (2) Secondary Solenoid—Energized by actuating the dual level float test switch or during internal fuel transfer and during "TRAIL."

j. HIGH-PRESSURE AIR SOLENOID—The valve ports high-pressure air to the buddy tanks during "DUMP." The reel tank dump valve must be open and the dump relay energized in order to energize the high-pressure air solenoid.

4-294C. FUNCTION OF IN-FLIGHT REFUELING TANKER SYSTEM ELECTRICAL SWITCHES.

a. DROGUE-STOWED SWITCH — Actuated when the drogue is stowed. It removes power from the coil of the rewind relay.

b. HYDRAULIC SLOWDOWN SWITCH — This switch is actuated 14 feet from the full rewind position. It allows the hose reel to slow down by energizing a hydraulic valve which restricts the rate of flow of hydraulic fluid to the reel motor.

c. 30-GALLON AND LOW LEVEL FLOAT SWITCHES (reel tank)—Refer to step j., paragraph 4-294A.

d. FULL TRAIL RELAY CONTROL SWITCH — This switch is deactuated just as the drogue enters the tunnel. It completes the initial power circuit for energizing the full trail relay.

e. FUEL TANK THERMAL SWITCH — Mounted in series. When hydraulic fluid reaches a temperature of 230°F, the switches open, removing power from the fuel tank air turbine solenoid. If the temperature of the fluid drops to 190°F, the switches will close, allowing normal operation of the fuel tank air turbine.

f. REEL TANK THERMAL SWITCH — Mounted in parallel. When hydraulic flluid reaches 230°F, the switches close, energizing the reel tank fuel pump shutoff solenoid. If the hydraulic fluid temperature drops to 190°F, the switches will reopen and allow normal operation of the reel tank fuel pump shutoff valve.

g. LOW FUEL SENSING FLOAT SWITCH—This switch is in the forward fuselage cell and actuates when the total internal tanker fuel has dropped to 950 pounds. The switch breaks the ground to the low fuel sensing relay and closes the internal fuel transfer valve. For functional check of thermal switches, refer to paragraph 1-26 in the Handbook of Overhaul Instructions (NAVAER 03-100-503).

h. SIX FOOT FROM FULL TRAIL SWITCH — The switch is actuated to the "LESS" position when the drogue is between full trail and 6 feet from full trail. When the hose is more than 6 feet from full trail, the switch deactuates to the "MORE" position. The switch controls the fuel hose shutoff valve by keeping the valve closed until the hose has reached full trail and reeled in at least 6 feet by the receiver aircraft.

i. FULL TRAIL SWITCH — This switch is on the aft lower left-hand side of the reel assembly and actuates when the hose reaches approximately 12 inches from full trail.

4-295. (DELETED.)

4-296. (Deleted.)

4-297. CHECKING IN-FLIGHT REFUELING TANKER SYSTEM. To check the in-flight refueling tanker system, consisting of a buddy fuel tank under the left-hand wing and a buddy reel tank under the right-hand wing, see figure 4-80 and proceed as follows:

a. The following equipment is required to accomplish this check: (1) A 28-volt d-c *constant voltage* source with a minimum capacity of 500 amperes to be plugged into the oval-shaped external power receptacle for electrical requirements other than starting. (2) A hydraulic power unit capable of delivering 3000 psi pressure with a flow up to 14 gallons per minute. (3) A source of air pressure (or nitrogen) free of moisture and incorporating an air filter. (4) An air shutoff valve, hose and fitting for attaching the air (or nitrogen) supply to the air supply system of the airplane. (5) A mat to break the fall of the drogue assembly when ejected from the reel tank. (6) An E6401 drogue adapter coupling (figure 4-84).

Note

The use of nitrogen for pressure testing the fuel system is recommended since nitrogen is an inert gas and, therefore, presents no explosion hazard when introduced into a fuel cell containing fuel vapors. A source of dry air could be used but, since this would increase the ratio of oxygen to fuel vapors in the cell, the possibility of an explosion would be increased; therefore, dry air is not recommended.

b. Check to see if the tanker control panel is correctly installed in the airplane and an electrical continuity check has been accomplished from the panel to the connections for the buddy tanks.

c. Check to see if the main fuel system has been defueled prior to starting this test.

d. (Deleted.)

CAUTION

The buddy tanks should not contain fuel until noted in this checking procedure.

e. Ensure the TRAIL—REWIND switch is in the "REWIND" position.

f. (Deleted.)

g. Check the D.C. POWER switch to be sure it is in the "OFF" position.

WARNING

Ensure that the landing gear ground lockpins are installed prior to deactuating the landing gear downlock switch. Deactuate switch by depressing downlock plunger with a screwdriver.

h. Disconnect the landing gear downlock switch located on the nose gear.

i. Detach the wing fuel scavenge pump air supply intermediate line assembly located in the right-hand wheel well at station 183 approximately 3 inches to the right of the airplane centerline (4). [On airplanes 139531i through 141458j and airplanes 143543l and subsequent, remove plug on air supply manifold at the forward engine bay bulkhead accessible through the right-hand engine access door (figure 4-69).]

j. Attach an air supply source (step a.) to the airplane B-nut fitting for the air supply line (4). Attach a hydraulic vari-drive (step a., 2) to the buddy fuel tank and the buddy reel tank at the ground servicing connections (5 and 6).

WARNING

Do not apply hydraulic power until noted.

k. Check to be sure the buddy tank hydraulic systems have been serviced (paragraph 4-297A) and checked.

l. Check to see that the GUILLOTINE switch, the INTERNAL FUEL TRANS switch and the MANUAL REFUEL—DUMP switch are in the "OFF" positions.

WARNING

Ensure that guillotine charge is removed.

m. Ensure that the airplane and tank vent lines have not been plugged.

n. Be sure the area can be used to refuel aircraft and the airplane is not within 50 feet of other aircraft.

CAUTION

Do not rewind the hose without a minimum tension of 300 pounds on the hose during ground operation or serious damage to the tank could result.

o. Apply electrical power, hydraulic power and air pressure to the tanks and airplane as noted in step a.

Note

To check the fuel dump air pressurization system, proceed with the following steps.

p. Move the MANUAL REFUEL—DUMP switch to "DUMP" position and check for a free flow of air from the buddy tanks' dump lines (7 and 8), indicating the airplane's air pressurization system is functioning properly.

q. Move the MANUAL REFUEL—DUMP switch to the "OFF" position. The free flow of air (7 and 8) should cease.

r. Shut off the air supply (4).

rA. Reconnect reel tank electrical disconnect.

s. Rotate the turbine in a counterclockwise direction as viewed from the front of the tank. The turbine blades (10) should move to the feathered position.

Note

To check extension of hose and drogue, use the following steps.

t. Position the TRAIL—REWIND switch to "TRAIL."

u. The drogue retaining latch (1) should open and the drogue assembly should be ejected from its socket.

CAUTION

- Disconnect electrical power if drogue fails to eject from tunnel. This will prevent the possibility of the drogue release solenoid becoming overheated.
- The mat should be placed under the tunnel to prevent damage to the drogue when ejected.
- To manually release the drogue mechanism in case of electrical failure, the rotary solenoid mechanism is accessible through hose reel access (bottom of the tank) with access door removed. See figure 3-3C in the Handbook of Overhaul Instructions (NAVAER 03-100-503) for location of the drogue release solenoid. The top finger of the rotary solenoid may be pushed rearward to release the drogue assembly. A hydraulic lock at the control valve will prevent the reel from unwinding if electrical power is not available. To overcome this, the control valve spool, at the left side of the reel assembly may be mechanically repositioned and the drogue can be pulled out manually.

v. The turbine blades (10) should snap down slightly, indicating the blades are in the unfeathered position. The red in transit light should illuminate.

Note

If, at any time during this operational check of the buddy tanks, an incorrect indication of the lights is noted, recycle the system at least one full cycle. A condition could exist in which the system could be out of sequence, due to the shutting off of electrical power before a full cycle has been completed.

w. Be sure the hydraulic pressure is shut off. Attach the E6401 adapter assembly [(6), step a.] to the drogue coupling (figure 4-84).

CAUTION

Be sure the hose is unwinding from its proper position on the hose reel before attempting to unwind the hose under pressure. (This may be determined by sighting through the tunnel and observing the hose.) This is most important, as flattening of the hose could result if one wind of the hose is looped over another wind, due to slack in the hose.

x. Apply 3000 psi hydraulic pressure and unreel the hose by applying and maintaining a restraining force of 450 pounds on the drogue coupling. (Use E6401 adapter assembly which incorporates a dynamometer and attach to front end of tug.) Very little force is required until 10 feet from full trail is reached.

Note

- A force of approximately 450 pounds will be required to maintain full trail position.
- The hose should be 53 (±3) feet in length and marked with a white band for every 10 feet of hose.
- Be alert for the reel recoil response as the drogue approaches the full trail position.

WARNING

The hydraulic test stand must be manned at all times when hydraulic pressure is applied to the tank.

y. The red (panel) in transit light should extinguish as the drogue coupling reaches the full trail position.

z. The amber (panel) ready light and the amber light (2) should illuminate.

aa. Position airplane's EXTERIOR LIGHTS master switch to "ON"; amber lights will dim and floodlight will illuminate. Return switch to "OFF" position.

ab. Simulate a receiver contact by reducing the force extending the hose to approximately 225 to 250 pounds.

ac. Permit hose to rewind to between 6 to 12 feet from full trail. At a point within the 6- to 12-foot range, the following events should occur: (1) the amber (panel) ready light should extinguish; (2) the amber light (2) should extinguish; (3) the green (panel) refuel light should illuminate; (4) the green light (3) should illuminate.

ad. Position the EXTERIOR LIGHTS master switch to "ON." The green light (3) should dim.

ae. Position the EXTERIOR LIGHTS master switch to "OFF." The green light should brighten.

af. To check operation of the float switches, add Grade 1010 oil or fuel until the 30-gallon float switch is actuated. This will be determined by the fuel pump beginning to operate.

CAUTION

Do not operate fuel pump longer than 5 seconds.

ag. Simulate a receiver disconnect by pulling the drogue coupling to the full trail position. The dynamometer should show a tension of 425 (+0/−25) pounds. At this point, the following should occur: (1) the green (panel) refuel light and the green light (3) should extinguish; (2) the fuel pump should shut off after approximately a 20-second delay; (3) the amber (panel) ready light and the amber light (2) should illuminate.

ah. With the hose in the full trail position, check the complete hydraulic system for signs of leakage.

Note

For guillotine and manual refuel check, proceed as follows:

WARNING

Be sure the guillotine charge is removed before making this check.

Note

The guillotine ground safety pin (14) must be removed for the following check.

ai. With the hose and drogue in the full trail position, shut off the hydraulic pressure to the tank.

aj. Ensure that the TRAIL—REWIND switch is in the "TRAIL" position.

ak. Position the MANUAL REFUEL—DUMP switch to "MANUAL REFUEL." The following events should occur: (1) the amber (panel) ready light and the amber light (point H) should extinguish; (2) the green (panel) refuel light and the green light (point G) should illuminate.

al. Return the MANUAL REFUEL—DUMP switch to the "OFF" position.

am. The turbine blades (10) should remain unfeathered.

an. Position the TRAIL—REWIND switch to "REWIND."

WARNING

Be sure the hydraulic pressure is shut off before positioning the switch to "REWIND."

ao. Position GUILLOTINE switch to "ON." Check for 28 volts dc at guillotine plug.

ap. Rotate the turbine (10) in a counterclockwise direction as viewed from the front of the tank. The turbine blades should return to the feathered position.

aq. Position the GUILLOTINE switch to "OFF."

ar. The turbine blades should return to the unfeathered position.

as. Position EXTERIOR LIGHTS master switch to "ON." The hose floodlight should illuminate. Position switch to "OFF."

at. Position the MANUAL REFUEL—DUMP switch to "MANUAL REFUEL."

au. The green (panel) refuel light should not illuminate.

av. Move the MANUAL REFUEL—DUMP switch to the "OFF" position.

aw. The turbine blades should remain unfeathered when the turbine is rotated counterclockwise (facing turbine, looking aft).

Note

- Ground tests on the reel tank can be accomplished, if desired, by removing pod from the airplane (paragraph 4-298) and attaching unit to the overhead arches of the Harco shipping container dolly, then securing cradle tow bar to the deck. Test set (E6449) will be required when tests are conducted with the pod removed from airplane. [Refer to the Handbook of Overhaul Instructions (NAVAER 03-100-503).]
- To check rewind of hose and drogue coupling, proceed as follows:

WARNING

- Ensure the E6401 adapter assembly is in good condition and correctly installed. Ensure the attaching bolts are properly torqued.
- Ensure the rewind restraining force is capable of withstanding a minimum load of 1200 pounds.
- The hydraulic test stand must be manned during the rewind test to shut off the hydraulic pressure in case of a cable or hose failure.

ax. Turn on the hydraulic pressure to the tank.

WARNING

- Ensure the TRAIL—REWIND switch is in the "TRAIL" position before applying hydraulic pressure.
- Do not rewind hose without restraining force of at least 350 pounds on the drogue.

ay. Move the TRAIL—REWIND switch to "REWIND."

az. The amber (panel) ready light and the amber (reel) light (2) should extinguish.

ba. The red (panel) in transit light should illuminate.

bb. The reel unit should exert a minimum force of 800 pounds as shown on the dynamometer that is part of the E6401 adapter assembly.

bc. Reduce the restraining force (300 to 350 pounds) to a point where it will permit the hose to rewind.

bd. Rewind the hose until the drogue is approximately 3 feet from the tank. At approximately 14 feet before the drogue stows, a considerable slowdown of hose rewind speed should be noted.

Note

- If slowdown is not observed, check adjustment of hose rewind slowdown switch. Refer to the Handbook of Overhaul Instructions (NAVAER 03-100-503).
- As the hose is rewound on the reel (15), ensure the level winding mechanism (16) is functioning properly.

be. Shut off the hydraulic pressure.

bf. Remove the E6401 adapter assembly.

bg. Slowly turn on the hydraulic pressure and continue to rewind the hose.

bh. As the drogue assembly seats in its socket, the red (panel) in transit light should extinguish.

bi. The drogue latch (1) should close.

bj. Return the turbine blades (10) to the feathered position.

bk. Shut off the hydraulic pressure.

bl. Position the GUILLOTINE switch to "ON." Check for 28 volts dc at guillotine plug.

bm. Install the guillotine ground safety pin (10 o'clock position at station 117).

bn. If oil was used to actuate float switch in step af., drain the Grade 1010 oil from tank. Be sure to drain the residual oil by opening tank drains (on bottom of tank).

bo. Connect electrical connection to fuel tank.

Note

Operational check of fuel tank consists of the following steps.

bp. Disconnect the electrical connection to the reel tank.

bq. Position the TRAIL—REWIND switch to "TRAIL."

br. The turbine blades (9) should snap down slightly, indicating the blades are unfeathered.

bs. Check the operation of the float switch by adding Grade 1010 oil or fuel until float switch is actuated.

bt. Momentarily apply 3000 psi hydraulic pressure to the tank's hydraulic system. Listen for the hydraulic-driven fuel pump to operate.

CAUTION

Do not operate the fuel pump longer than 5 seconds.

bu. Shut off the hydraulic pressure.

bv. Position the TRAIL—REWIND switch to "REWIND."

bw. Rotate the turbine in a counterclockwise direction as viewed from the front of the tank. The turbine blades (9) should return to the feathered position.

bx. Position the MANUAL REFUEL—DUMP switch to "DUMP." The following events should occur: (1) the turbine blades should unfeather; (2) momentarily apply 3000 psi hydraulic pressure and listen for the fuel pump to operate.

by. Position the MANUAL REFUEL—DUMP switch to "OFF."

bz. The turbine blades should return to the feathered position.

ca. If Grade 1010 oil was used during this check, drain the oil from the tank. Be sure to drain the residual oil by opening the tank drains on bottom of tank.

caA. Reconnect reel tank electrical disconnect.

Note

To check fuel transfer system and hose floodlight, proceed as follows:

cb. Fill buddy fuel tank with 75 gallons of fuel through the gravity filler cap (11).

cc. Place a mat under the drogue socket (20) to prevent damage to the drogue when ejected.

cd. Move the TRAIL—REWIND switch, located on the tanker control panel, to "TRAIL."

ce. The drogue (20) should release from the latching mechanism.

cf. Apply hydraulic pressure to the buddy fuel tank (5).

cg. Sight through the reel tank gravity filler cap (12) and observe that the fuel is being transferred into the reel tank.

ch. Fuel flow should cease within ½ minute after hydraulic pressure is applied, indicating the cross ship fuel transfer valve opened properly and the fuel has been transferred at the required rate.

ci. Shut off the hydraulic pressure (5) immediately after the fuel flow ceases.

cj. Replace the gravity filler cap (12) on the reel tank.

ck. Move the buddy fuel tank turbine in a counterclockwise direction as viewed from the front of the tank. The turbine blades (9) should move to the feathered position indicating the fuel tank empty switch has opened properly.

cl. Check the hose floodlight on the buddy reel tank (13) as follows:

cm. Place the EXTERIOR LIGHTS master switch, located at the forward end of the right-hand console, to the "ON" position. The hose floodlight (13) should illuminate brightly.

cn. Place the EXTERIOR LIGHTS master switch in the "OFF" position. The hose floodlight (13) should extinguish.

co. Move the TRAIL—REWIND switch to the "REWIND" position.

cp. Slowly apply hydraulic pressure (6) to the reel tank and rewind the hose and drogue.

cq. As the drogue (20) seats in the socket, the in transit light should extinguish.

cr. After the drogue retaining latch closes, shut off the hydraulic pressure (6).

cs. The turbine blades on the reel tank should feather when the turbine (10) is rotated in a counterclockwise direction, indicating the turbine solenoid has been deenergized.

ct. Fill the buddy fuel tank with 125 gallons of fuel through the gravity filler cap (11).

cu. Place the ENGINE MASTER switch in the "MASTER" position and move the DROP TANK FUEL TRANSFER switch, located at the aft end of the left-hand console, to the "INBD" position.

cv. Apply air pressure (step j.).

cw. Fuel should be transferred from the buddy tanks to the main fuel system.

cx. At approximately 950 pounds of fuel, as indicated on the fuel quantity gage (sump position), the low fuel warning light should extinguish, indicating fuel has been transferred from the buddy tanks to the main fuel system.

cy. Shut off the air pressure (4).

cz. Move the DROP TANK FUEL TRANSFER switch to the "OFF" position.

da. Move the INTERNAL FUEL TRANS switch to the "ON" position. Fuel from the main fuel system should transfer to the buddy tanks.

db. At approximately 950 pounds of fuel, as noted on the fuel quantity gage (sump position), the low fuel warning light should illuminate, indicating the internal fuel transfer valve (17) has opened properly and fuel has been transferred to the buddy tanks.

dc. After the low fuel warning light illuminates, remove the gravity filler caps (11 and 12). Ascertain that no fuel is being transferred to the buddy tanks, indicating the internal fuel transfer valve (17) closed when the low fuel warning switch was actuated.

dd. Move the INTERNAL FUEL TRANS switch to the "OFF" position.

de. Place the ENGINE MASTER switch in the "OFF" position.

df. Replace the gravity filler caps (11 and 12).

dg. Service the airplane with fuel (paragraph 1-34). Check the fuel level control valves for operation (paragraph 4-216) during the first minute of refueling.

dh. Disconnect the electrical power from the airplane.

di. Disconnect the hydraulic power supply from the tanks.

dj. Disconnect the air supply line from the airplane and reconnect air scavenge line or air scavenge line plug.

dk. Replace all access doors and covers which were removed for checking the buddy tanks and airplane's buddy tank system.

dl. Actuate the landing gear downlock switch located on the nose gear by removing screwdriver.

dm. Remove the gravity filler caps from the buddy tanks (11 and 12) and visually determine that the tanks are full. Replace caps.

dn. Connect or reinstall guillotine charge.

CAUTION

The buddy tanks may be slightly pressurized after refueling operations. Carefully crack open the filler caps to relieve any pressure prior to making a visual inspection of the buddy tanks.

4-297A. SERVICING THE BUDDY REEL AND FUEL TANK HYDRAULIC SYSTEMS.

Note

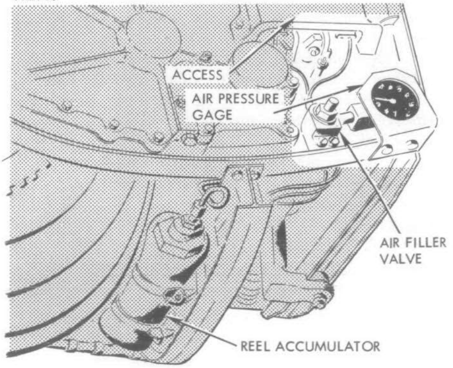
- Use only hydraulic fluid (Specification MIL-O-5606).
- When any component of the hydraulic system is replaced it must be primed (filled) with hydraulic fluid before installation.
- To bleed the air from the lines of the hydraulic system of the right-hand tank, apply hydraulic pressure at 1200 psi and operate from 2 to 4 minutes or until the system is bled of air.

Warning The tank must contain a minimum of 25 gallons of fuel, otherwise the fuel pump will be severely damaged.

- To bleed the air from the lines of the hydraulic system of the left-hand tank when installed on the airplane, position the TRAIL - REWIND switch to "TRAIL" and the MANUAL REFUEL - DUMP, GUILLOTINE and INTERNAL FUEL TRANS switches to "OFF" and apply hydraulic pressure at 1200 psi for 2 to 4 minutes or until the system is bled of air.
- To bleed the air from the lines of the hydraulic system of the left-hand tank when not installed on the airplane, fabricate a suitable hose assembly from the outlet nipple to the gravity filler opening, to prevent fuel from being pumped overboard and apply hydraulic pressure at 1200 psi for 2 to 4 minutes or until the system is bled of air.

Warning Whether on or off the airplane, the tanks must contain a minimum of 25 gallons of fuel, otherwise the fuel pump will be severely damaged. Do not run the fuel pumps in excess of 4 minutes as the fuel will become extremely hot.

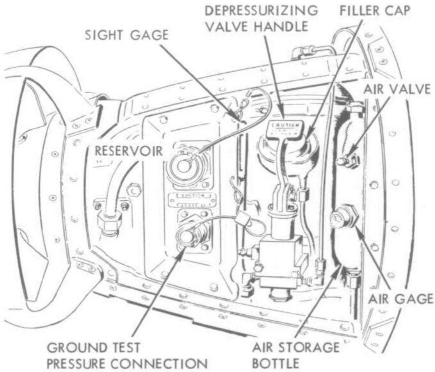
1 Remove the access door on the left-hand side of the nose section of each tank. On the reel tank, remove small access door on left-hand side of reel access door to gain access to the reel accumulator air gage and filler valve.



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2 Precharge the reel accumulator (left-hand side of reel compartment) to 1250 (±25) psi with dry air or nitrogen through the air filler valve.

3 Place the hydraulic reservoir depressurizing valve handle (left-hand side of nose section) down (thus depressurizing the reservoir and blocking air pressure in the air bottle) and remove filler cap.



4 Fill the reservoir by one of the following methods:

A. Fill the reservoir to the full mark on the sight gage with hydraulic fluid (Specification MIL-O-5606) from a clean container.

B. Fill the reservoir by using the ground test stand. Attach the test stand pressure line to the ground test pressure connection. The test stand pump suction should be connected to an external source of fluid such as a test stand reservoir. Set test stand for a flow of one gpm maximum and a pressure of 1200 psi maximum. Operate test stand until fluid level reaches the full mark on the sight gage, then shut off and remove.

Caution Do not fill reservoir above the full mark on the sight gage. Always remove the filler cap to permit excess fluid to drain overboard.

5 Replace the filler cap and return depressurizing valve handle to its original position.

6 Precharge the air storage bottle to 1900 (± 25) psi with dry air or nitrogen.

7 Install hydraulic reservoir access door (on reel and fuel tank) and small access door on reel section.

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4-297A-1. CHECKING RAM-AIR TURBINE. To check ram-air turbine, proceed as follows:

a. Check the clearance between the turbine blades and the shroud ring for a minimum clearance of 0.050 inch. This clearance will ensure that flight deflections will not allow the blades to rub the shroud ring.

Note

Check turbine blades for pitting, corrosion and alignment.

b. Rotate the turbine by hand. It should turn freely except for the drag produced by the build-up of hydraulic pressure. Listen carefully for bearing noise while turning turbine. (Noise will indicate bearing damage.)

c. With the turbine control solenoid de-energized (power off), and the turbine blades set at an angle well away from the feathered position, rotate the turbine by hand in the normal direction (counterclockwise, looking aft) until the blade angle ceases to increase and the solenoid brake is felt to slip. Measure the blade angle by checking to see that mark "F" (marked on the turbine spinner at each blade) aligns with the trailing edge of each individual blade. (This will ensure that the turbine will stop rotating and will create a minimum of drag (in flight) in the feathered position.

d. With the turbine blades aligned at mark "F" (step c.), energize the solenoid with 18-volt d-c power. The trailing edge of each blade should immediately turn past blade angle mark "O.R." (This is the operating range of each blade.)

Note

All four turbine blades must turn in unison with only slight play between individual blades and the co-ordinating mechanism.

e. Grasp any two opposite turbine blades and twist them in opposite directions (with control solenoid still energized). There should be free movement of the blades when turned toward the feathered position up to the point of contact with the unfeathering springs (approximately a 60-degree blade angle). Also, there should be free movement of the blades when turned toward the unfeathered position up to the point of contact with the elastic, low blade stop (approximately a 45-degree blade angle). Beyond these points (degrees), resistance to blade angle change will increase drastically. There may be a slight difference in the torque required to twist one pair of opposite blades as compared to the torque required for the other pair of blades, but this condition is normal.

f. De-energize the control solenoid (by removing electrical power) and check that the blade angle changes with the rotation of the turbine.

4-297B. REMOVING AND INSTALLING EXPLOSIVE CHARGE IN GUILLOTINE ASSEMBLY.

1

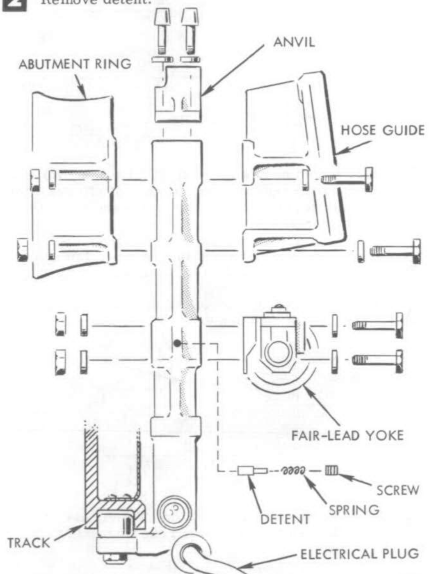
A. Disconnect electrical plug from guillotine assembly.

B. Remove hose guide, abutment ring and plate from guillotine.

C. Remove fair-lead yoke and anvil.

D. Lift hose and slide guillotine to the extreme right-hand side of reel and remove from tracks.

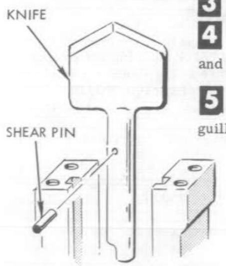
2 Remove detent.



3 Remove the knife.

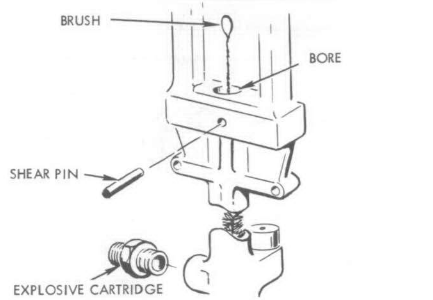
4 Remove the broken parts of shear pin from body and knife.

5 Remove the spent explosive cartridge from guillotine.



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6 Clean the bore of body and shaft of the knife with solvent (acetone, alcohol, carbon tetrachloride may be used as solvents).



7

A. Replace the knife (aligning the shear pin holes) and insert new shear pin (3/32-inch groove pin).

B. Install detent.

8 Install guillotine in reel.

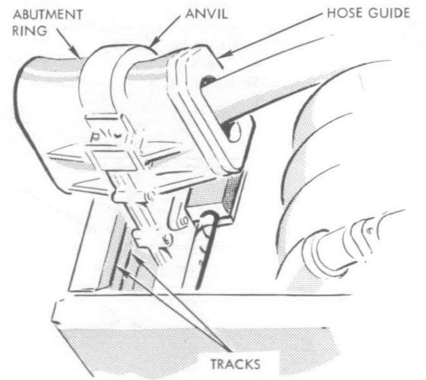
9 Attach fair-lead yoke and anvil. Safety wire anvil cap screws.

10 Connect hose guide, abutment ring and plate to guillotine.

11 Install new explosive cartridge (BW 10010, Beckman-Whitley). Safety wire cartridge.

12 Connect the electrical plug to explosive charge and install safety wire.

Warning Install guillotine ground safety pin before connecting the electrical plug.

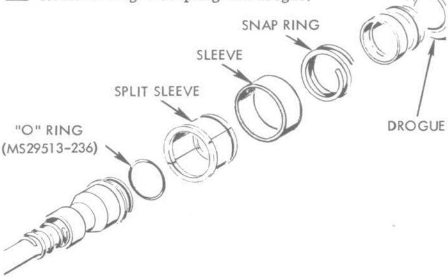


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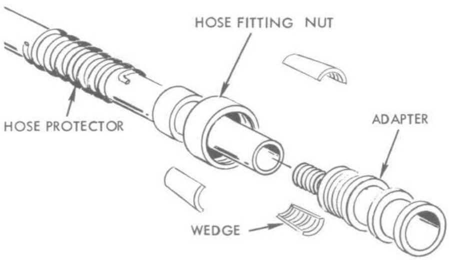
4-297C. REMOVING AND INSTALLING REEL HOSE.

1 Extend reel hose (paragraph 4-297).

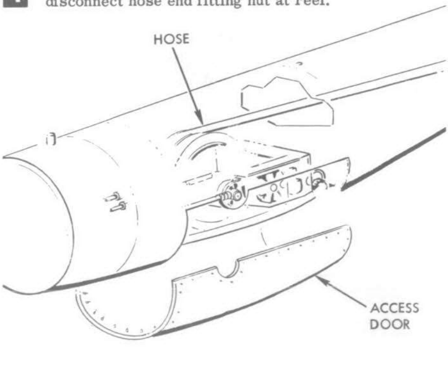
2 Remove drogue coupling and drogue.



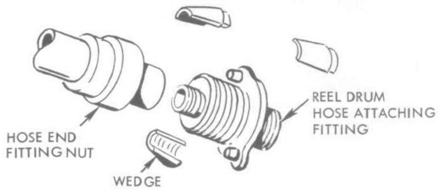
3 Remove hose fitting.



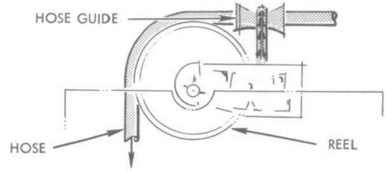
4 Remove reel access door and with hose fully extended, disconnect hose end fitting nut at reel.



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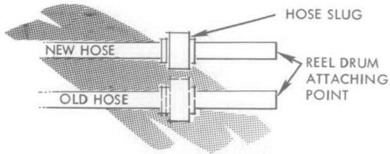
5 Pull hose through hose guide from bottom of reel to remove.



6 Before installing new hose, stretch hose at 1800 pounds tension for five (5) minutes. (This will eliminate the hose stretching during the first few cycles and avoid re-setting the hose reel switches.)

7 Cut hose the exact length of the old hose, this may eliminate readjusting the reel switches.

8 Install hose slug on new hose at the same distance from the reel end as the old hose.



9 Thread new hose up from bottom of reel, over the drum, through the fairlead and out the tunnel (see step 5).

10 Install hose-end fitting nut at reel, fitting at the aft end of the hose, drogue coupling and the drogue.

Note

- Check the drogue for freedom of movement on the drogue coupling, also check coupling for proper lubrication. See figure 2-29, Handbook of Overhaul Instructions (NAVAER 03-100-503) for lubrication requirements.
- Check drogue for damage resulting from in-flight refueling operations.

11 Check adjustment of hose reel switches per NAVAER 03-100-503 and adjust if necessary.

12 Rewind reel hose and install reel access door.

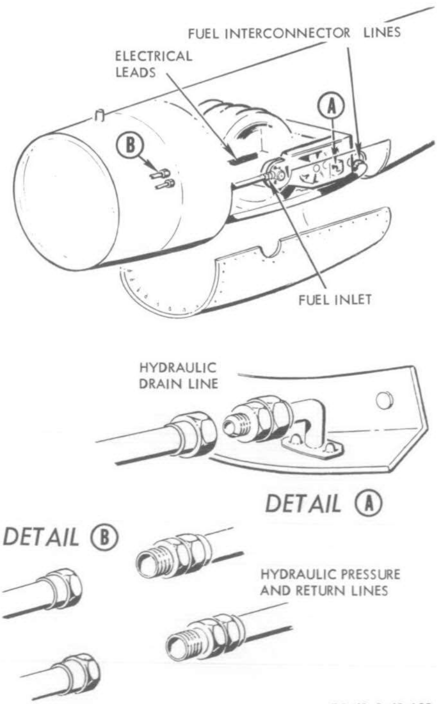
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4-297D. REMOVING AND INSTALLING HOSE REEL.

REMOVING

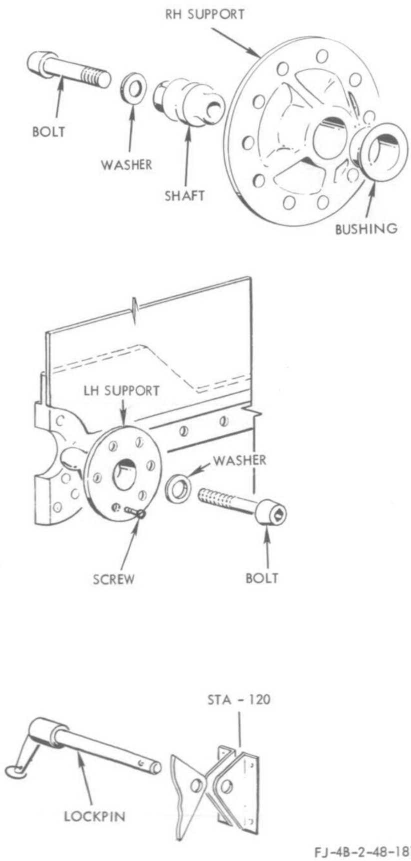
Note To remove the hose reel, refer to NAVAER 03-100-503 for the reel removal dolly (Part No. E-6411) and proceed as follows:

1. Remove reel access door.
2. Remove fuel interconnector lines.
3. Remove hydraulic drain line.
4. Disconnect fuel inlet line at reel.
5. Disconnect hydraulic pressure and return lines.



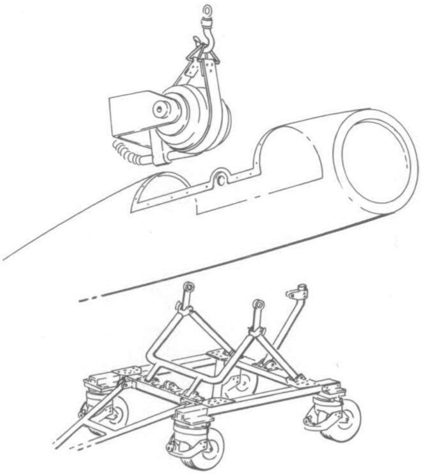
FJ-4B-2-48-180

6. Extend hose and remove drogue coupling and drogue (figure 4-297). Rewind hose.
7. Disconnect electrical leads on reel terminal strip.
8. Position E6411 dolly assembly under reel. Jack the cradle pad firmly against reel.
9. Remove support fittings (trunnions) on right - and left- hand sides of reel.
10. Remove lockpin attaching reel to bulkhead at station 120.



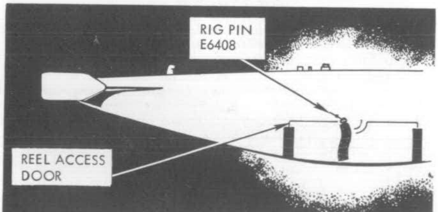
FJ-4B-2-48-181

11 Lower reel onto E6411-101 transport dolly. Connect support bar (folded on lower portion of dolly) to end of reel to provide rigid support.



1 Place sling around reel and hoist from E6411-101 transport dolly.

2 Lower reel into place and install left-hand support and E6408 rig pin in place of right-hand support.



3 Install Ball-Lock pin supporting reel at station 120 bulkhead.

4 Install shaft seal and right-hand reel support. Remove E6408 rig pin.

5 Torque left- and right-hand reel supports (trunnions) from 90 to 144 inch-pounds.

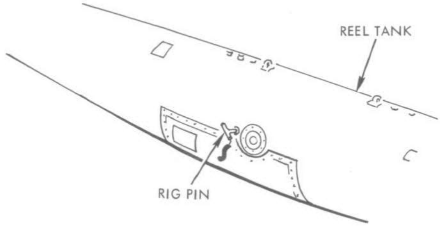
6 Connect fuel, and hydraulic lines and electrical leads from tank to reel. See NAVAER 03-100-503 for wiring data.

7 Extend reel hose and install drogue (paragraph 4-297D).

FJ-4B-2-48-206A

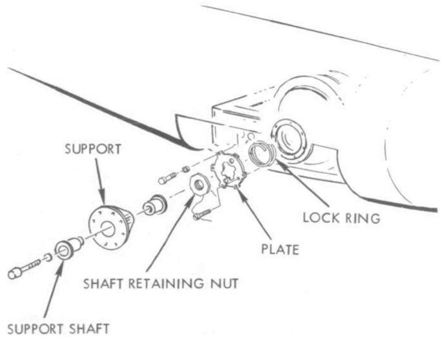
4-297E. REPLACEMENT OF REEL SHAFT SEAL.

1 Install E-6408 seal replacement rig pin in rig pin hole located on the right-hand side of reel tank slightly aft of trunnion fitting.

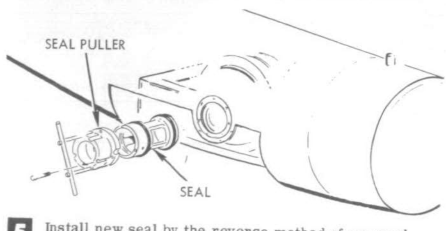


2 Remove support, support shaft and bushing from reel tank.

3 Remove shaft retaining nut, plate and lock ring from reel.



4 Install 217802 (Flight Refueling, Inc.) seal puller and remove seal by applying a pulling and turning force.



5 Install new seal by the reverse method of removal. Lubricate shaft seal "O" rings with petrolatum (item 100, materials list) before installing shaft seal. Safety wire shaft seal retaining nut. Remove seal replacement rig pin.

FJ-4B-2-48-189

4-298. REMOVING AND INSTALLING BUDDY TANKS.

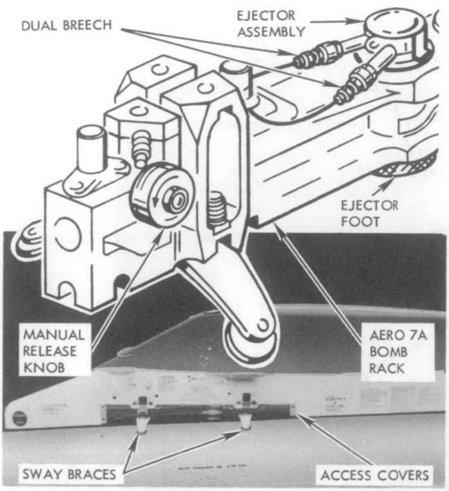
REMOVING

Note For removal and installation of the reel tank or fuel tank from the 1502 shipping container, refer to Handbook of Overhaul Instructions (NAVAER 03-100-503) (figure 2-2 and 2-3).
The handling dolly, (C1502-4-1) (figure 4-84) furnished as a part of the shipping container, may be used to transport a tank full of fuel.

Warning

- Do not transport a full tank when supported by the winch straps only. If draining the tanks is impossible, the upper support bars and lifting lugs must be installed for transporting.
- Before any attempt is made to remove or handle a fuel tank, electrically ground each tank in addition to grounding the airplane.
- Be sure the ENGINE MASTER switch is in the "OFF" position and external power source is disconnected from airplane.

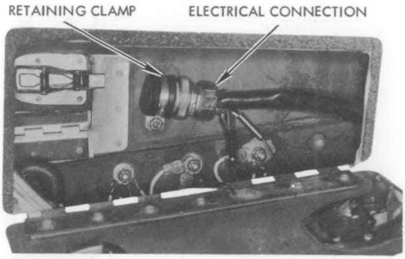
1. Drain tanks. (Refer to paragraph 1-35.)
2. Position suitable padded cradle, stand or dolly under tank (not more than 2 inches from tank).
3. Remove access covers on left- and right-hand sides of pylon.



Warning Be sure explosive cartridges are removed from both breeches before removal of tank is attempted.

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4. Insert special tool No. T2733 between bomb rack and outside fairing of pylon (slightly forward of front sway brace) and position on manual release knob.
5. Rotate MANUAL RELEASE knob (180 degrees counterclockwise) and tank will release.
6. Install cover plug in bottom of pylon over air pressure and fuel line openings.
7. Secure electrical connection inside of pylon.

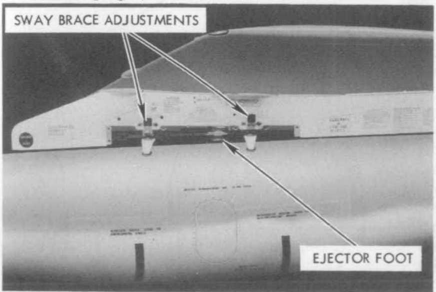


INSTALLING

1. Install universal pylon. (Refer to paragraph 7-155.)
2. Remove access doors on left- and right-hand sides of pylon.
3. Open bomb rack hooks by inserting special tool No. T2733 between bomb rack and outside fairing of pylon. Position on MANUAL RELEASE knob. Rotate knob 180 degrees counterclockwise.
4. Screw ejector foot up into bomb rack sufficiently to clear the tank during tank installation. Raise sway brace adjustment bolts to provide tank clearance.

Warning

- Connect ground wire between tank structure and airplane structure in addition grounding airplane, prior to installing tanks that have contained fuel, (if they have not been purged).

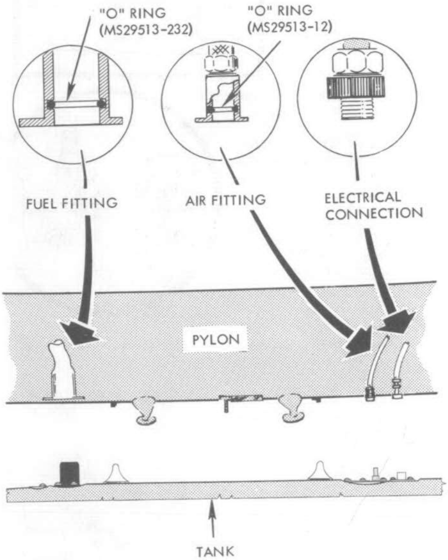


5. Position tank under wing on an adjustable dolly and align with bomb rack.

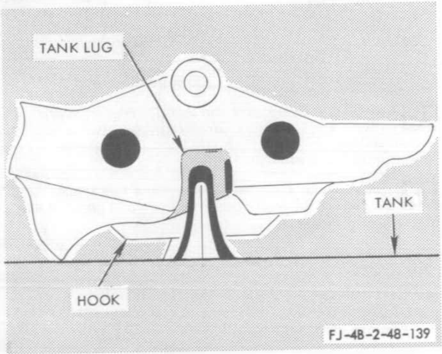
FJ-4B-2-48-171A

Warning Connect a ground wire from the metallic structure of the tank to the metallic structure of the airplane. Ground the airplane with a separate ground wire from airplane to ground.

6 Lubricate "O" rings with petrolatum (item 100, materials list) and install "O" ring (MS29513-12) in groove on inside of pylon air line fitting. Install "O" ring (MS29513-232) in groove inside of tank fuel nipple.



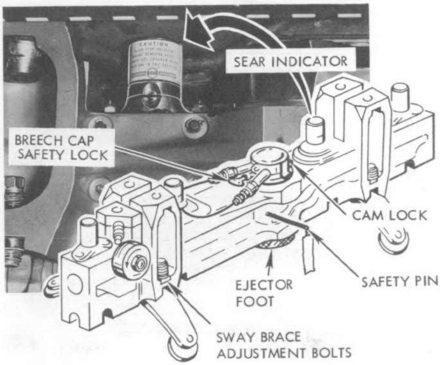
7 Raise tank until tank lugs enter bomb rack and hook recesses sufficiently to close rack hooks.



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8 Install ground safety pin in bomb rack.

9 Visually check sear indicators to ensure that bomb rack hooks are properly latched. (Black lines should align.)

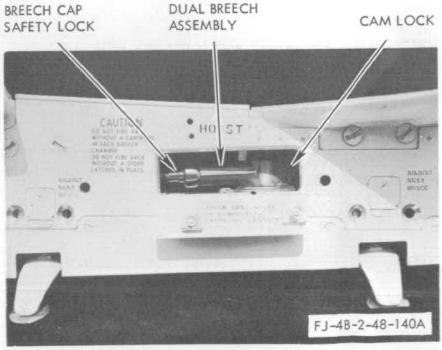


10 Screw ejector foot down until light contact is made with tank.

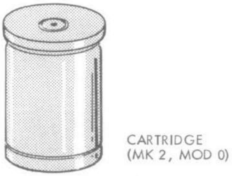
Warning Tight adjustment may cause tank release.

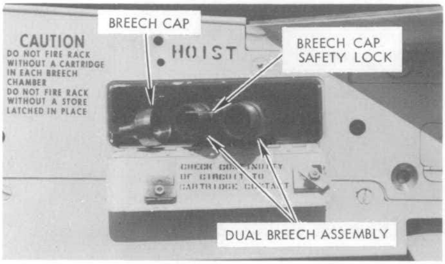
11 Adjust sway brace adjustment bolts (two bolts on each side of rack) to seat sway braces lightly against tank. Torque all sway brace adjustment bolts one-fourth turn; then tighten all adjustment bolts an additional one-fourth turn for a total of one-half turn.

12 To install new cartridges, depress breech cap safety lock and remove breech caps. Turn breech cam lock (rear of breech) and pivot breech assembly outward. Remove old cartridges and install new Mark 2, Mod 0 cartridges inside the dual breech.

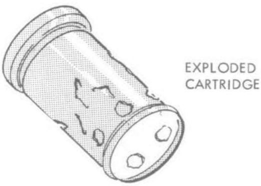


FJ-4B-2-48-140A





Caution If cartridges have exploded as shown, remove the cartridges from the breeches and clean fragments from the breeches before loading new cartridges.



13 Align dual breech with bomb rack until cam lock engages. Install breech caps and make certain breech cap safety lock fits behind back of caps.

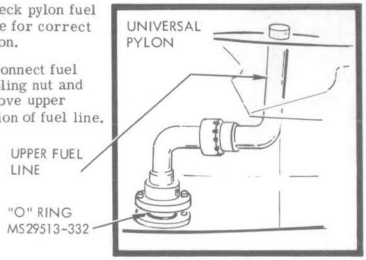
Caution Do not fire rack without a cartridge in each breech chamber. Do not fire rack without a store or tank latched in place.

14 Connect electrical plug to tank electrical connection.

FJ-4B-2-48-153A

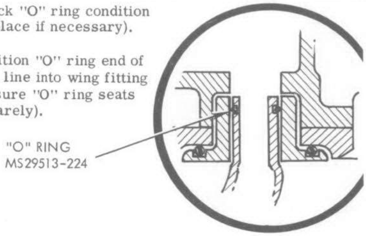
15 Check pylon fuel line for correct installation.

A. Disconnect fuel coupling nut and remove upper section of fuel line.

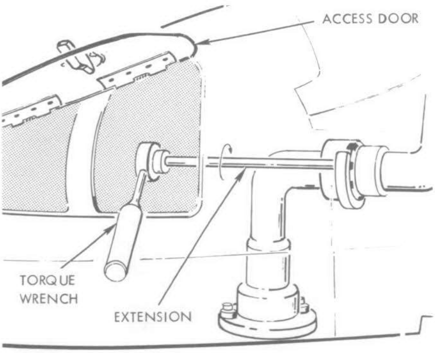


B. Check "O" ring condition (replace if necessary).

C. Position "O" ring end of fuel line into wing fitting (be sure "O" ring seats squarely).



D. Connect fuel coupling nut and torque to correct value (see figure 4-8).



16 Close all access doors and install access covers on left- and right-hand sides of pylon. Be sure to reinstall ground safety pin after installing access covers. Remove grounding wires.

17 Install buddy tank control panel and fuel transferred indicator in cockpit (on vertical console and instrument shroud).

Warning The T-208 and T-249 control box assemblies must be removed from the airplane (vertical console) before the buddy tank installation can be performed or permanent damage to electrical components and associated equipment will occur.

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ALPHABETICAL INDEX

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